Iron and Steel ENGINEER

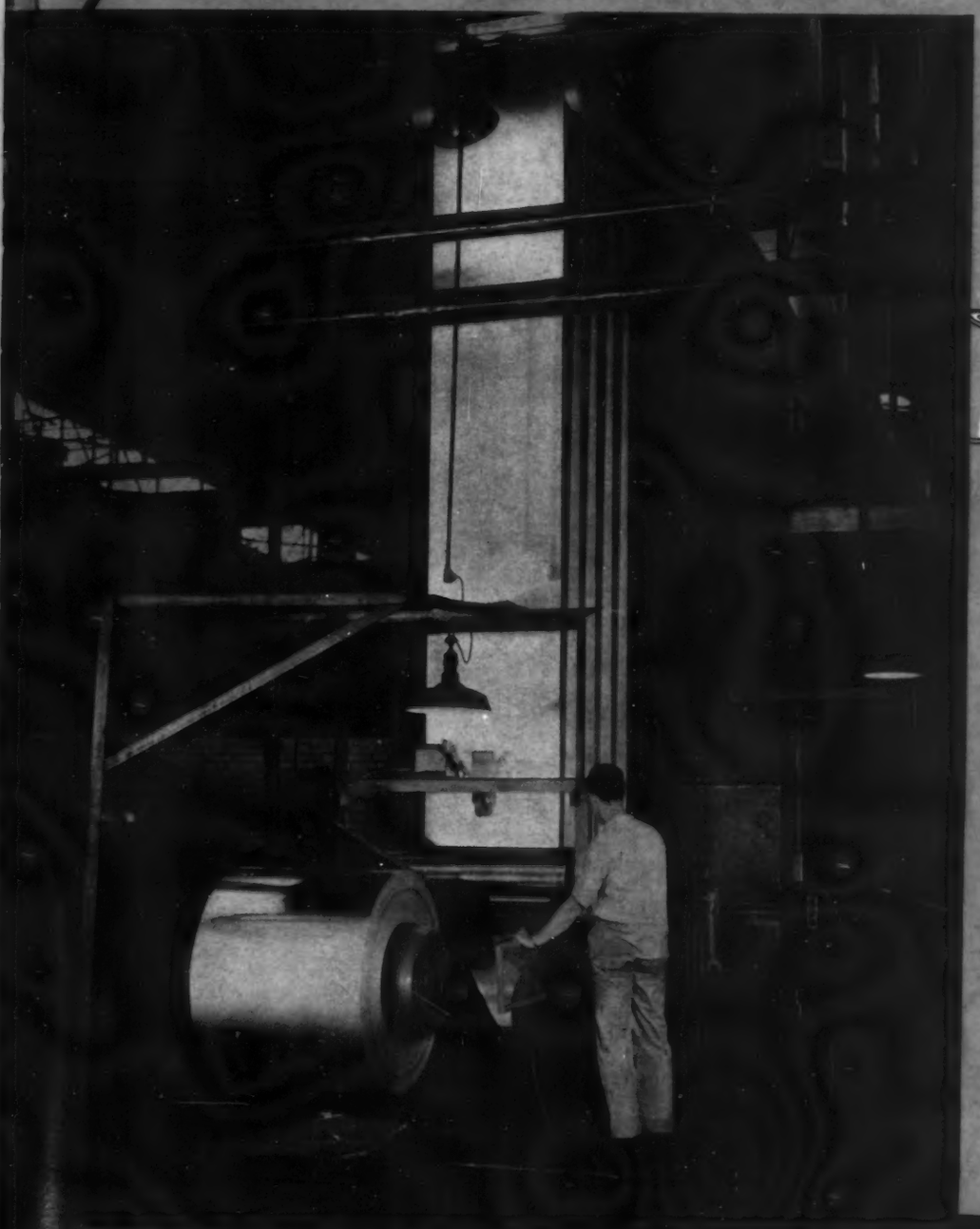
ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

1010 EMPIRE BUILDING | JANUARY, 1947 | PITTSBURGH, PENNSYLVANIA

CONTINUOUS *Electrolytic* TIN PLATING LINES

built by

MESTA



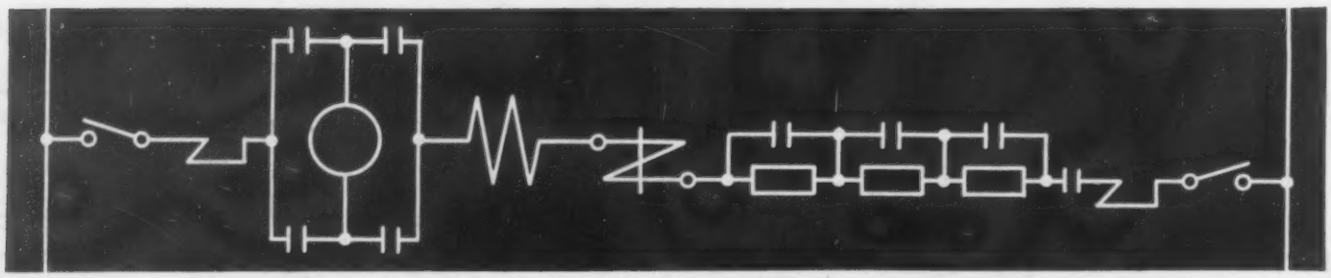
Discharge end of MESTA 42" Continuous Electrolytic Tin Plating Line

MESTA MACHINE COMPANY · PITTSBURGH, PA.

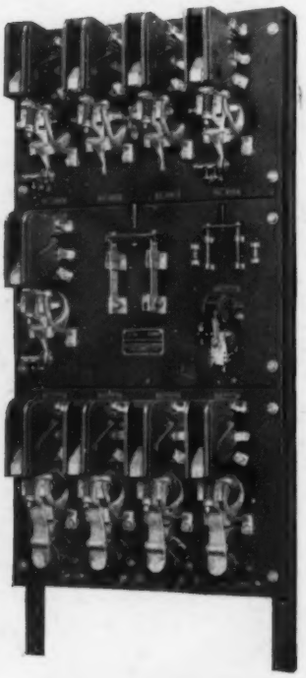
√R v.24 Jan.-June 1947

What control for what mill equipment? One of a SERIES of advertisements featuring basic heavy duty power circuits . . . and showing Cutler-Hammer's broad design and application experience which has made it *the* preferred control for the steel industry.

D. C. reversing plugging control



When you have an installation such as a reversing table, where load and performance characteristics dictate the use of a series wound motor which must be frequently and rapidly reversed. . . .



Typical Components of Cutler-Hammer Mill Control

Then . . . call for Cutler-Hammer Control No. 14010

Cutler-Hammer Bulletin No. 14010 offers the following advantages:

ACCELERATION.... Cutler-Hammer Inductive Time Limit Control, a pioneering development of this company, accelerates all loads alike, smoothly, safely, uniformly. The simplest accelerating system, eliminating relays, dashpots and other parts that commonly give trouble.

PLUGGING PROTECTION.... gained without the need of auxiliary relays, typical of the simplicity of Cutler-Hammer design.

EQUIPMENT.... Conforming to NEMA standards. Available in ratings up to 1800 amperes. In open, enclosed or complete factory assembled ready to wire units. A complete line of control accessories.

USERS PREFER CUTLER-HAMMER CONTROL because they know Cutler-Hammer as the oldest in control specialization, pioneering such important achievements in steel mill practice as crane control, ore bridge control, inductive time limit control, etc. In fact the control for the first electrically driven mill was . . . Cutler-Hammer Control.

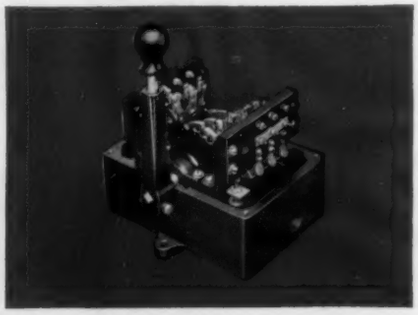
They know too from personal experience that C-H control is not stinted in any of its parts, that in every detail Cutler-Hammer control is *engineered* control, *by* engineers *for* engineers.

Finally, users have found constant betterment, constant improvement. Quality has never slipped back, has never long stood still, has always moved forward.

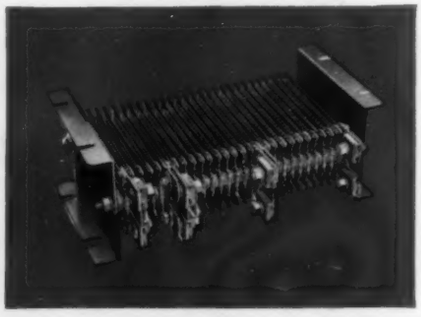
These are some of the reasons why so many men in steel say: "Give me C-H control every time." CUTLER-HAMMER, Inc., 1269 St. Paul Ave., Milwaukee 1, Wis. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ont.

CUTLER-HAMMER
MOTOR CONTROL
C-H

Mill Contactor
The mill-type contactors whose reliability, life and low maintenance have made them the standard for the industry.



Mill-Master (Cover removed)
Compact construction with cam-operated twin break contacts. Preferred because of its ease of operation.



Dur-Ristor
The durable, unbreakable mill duty resistor with the single, continuous strip resistor element of tough alloy.

Tech.

How do you measure QUALITY?

Aetna-Standard has two big plants equipped with a diversified assortment of tools. This is the main bay of the Ellwood City, Pa., plant.

The hard-boiled facts of original investment balanced by quality of product, plus cost per piece usually tell the quality story on production equipment.

Aetna-Standard specializes in designing and building production machinery to efficiently produce, form, and finish steel, brass, copper, and aluminum.

As specialists, we combine experience, facilities, and knowledge for the one purpose — *building the most efficient mill equipment for your use.*

In several classifications, notably seamless tube mills; continuous butt-weld pipe mills; coating equipment; drawbenches; continuous galvanizing and flat rolled finishing equipment and others, *Aetna-Standard equipment has set the quality standard for the industry.*

THE AETNA-STANDARD ENGINEERING COMPANY
YOUNGSTOWN, OHIO

ASSOCIATED COMPANY: HEAD, WRIGHTSON & COMPANY, LTD., MIDDLESBROUGH, ENGLAND

DESIGNERS AND BUILDERS to the Steel, Non-Ferrous and Chemical Industries

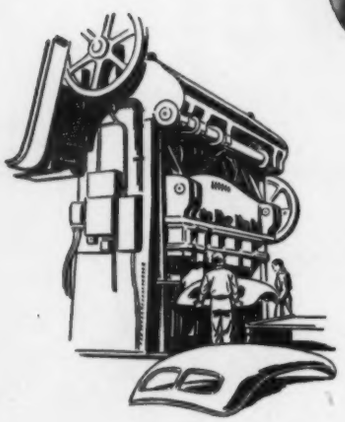
ROLLING TECHNIQUE . . .

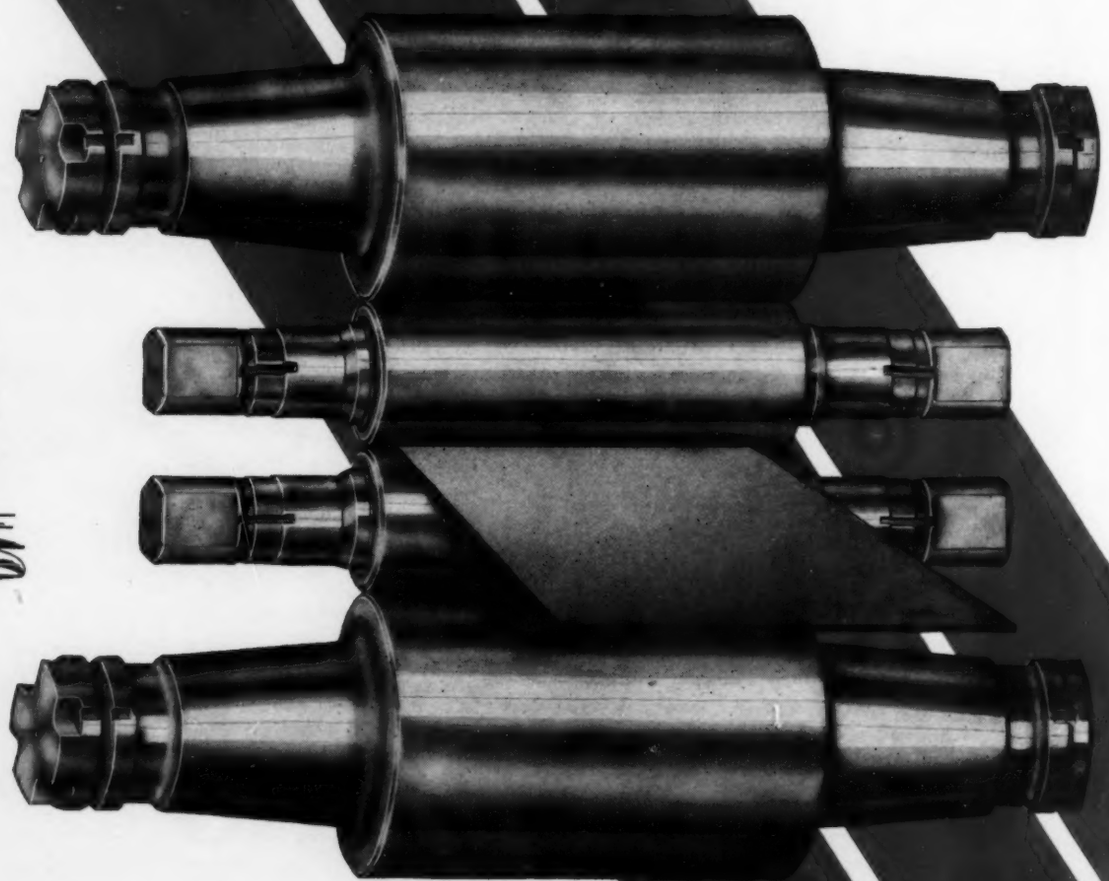
Strip Mills

Today's production lines turning out new automobiles, new airplanes, new appliances, and many other items demanded by the consuming public, require thousands of tons of coiled strip for stamping and forming.

Pittsburgh Rolls alloy iron *work rolls* and alloy steel *back up rolls* in four-high strip mills are rolling aluminum, brass, copper and magnesium, as well as steel, and are successfully producing flat rolled products *at less cost per ton rolled.*

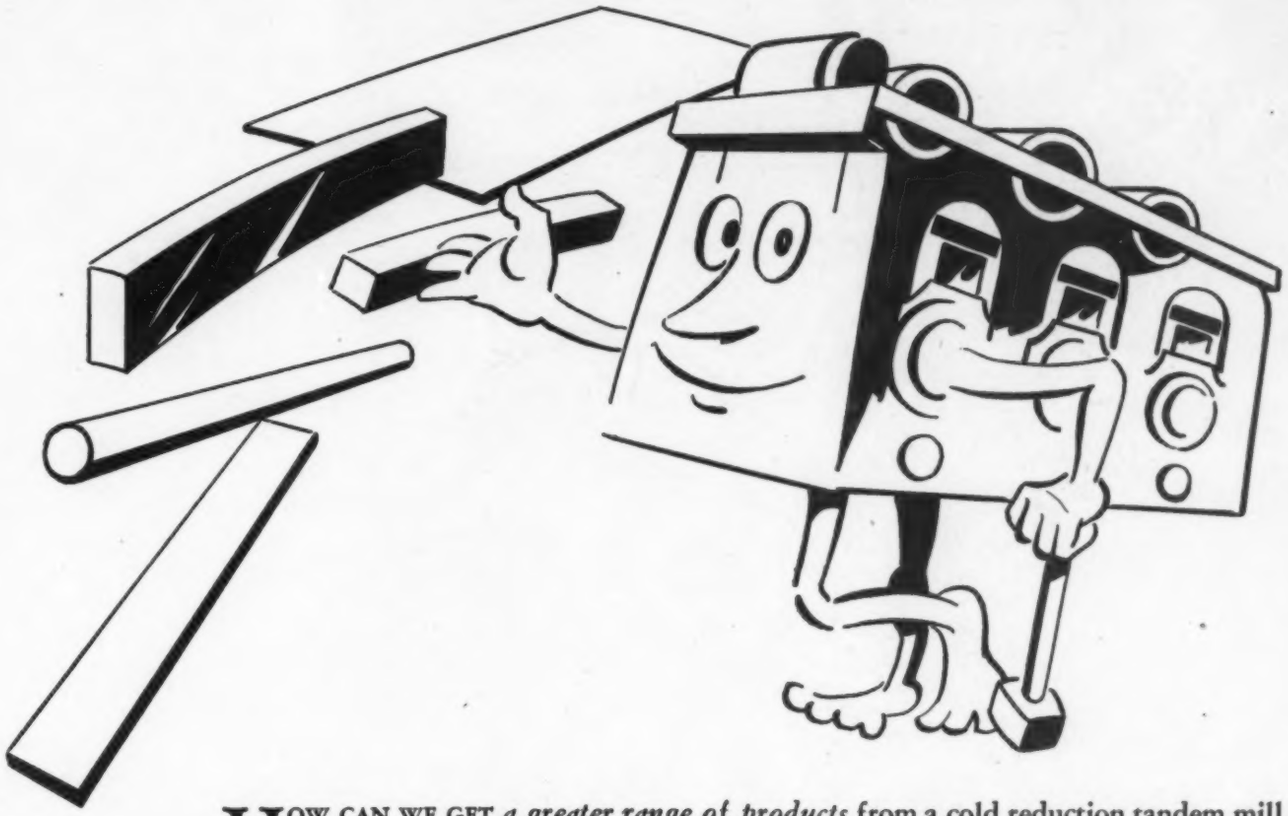
PITTSBURGH ROLLS
DIVISION OF BLAW-KNOX COMPANY
Pittsburgh, Pa.





PITTSBURGH ROLLS

"The Tandem Mill That Became Jack-of-all Trades"



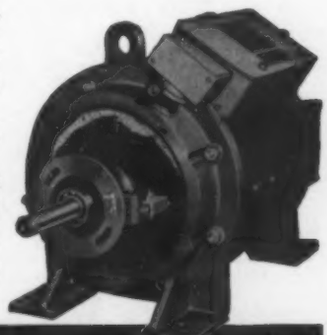
HOW CAN WE GET *a greater range of products* from a cold reduction tandem mill, using the same stock?" pondered a steel plant operator.

He knew that a tandem mill is only as flexible as its control system for changing roll speeds of consecutive stands; and that in a conventional system, where all motors feed from a common generator bus, the speed of motors can only be changed within definite limits by field weakening.

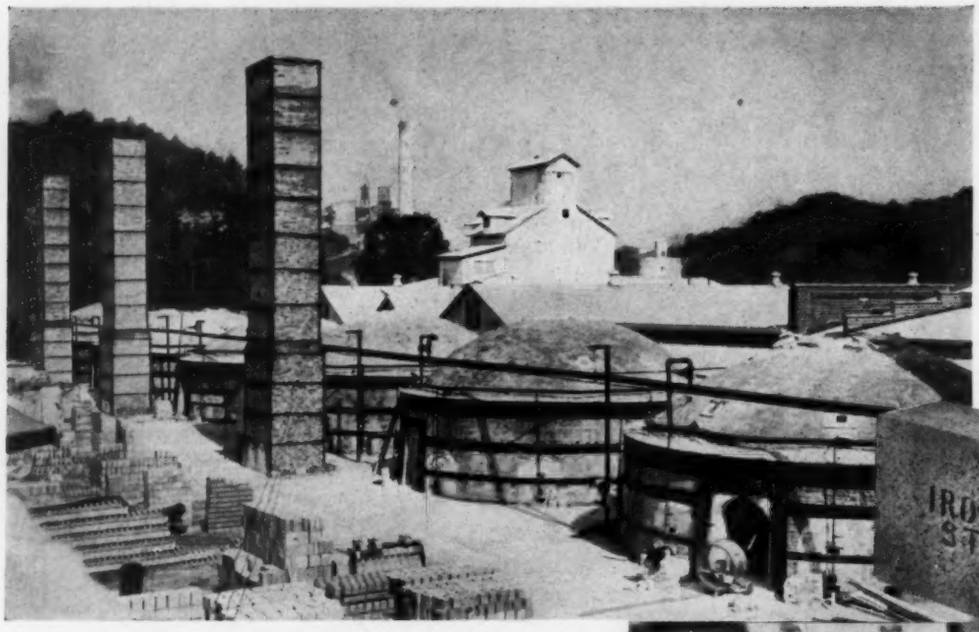
Solution? To specify a mill with an *individual generator* for each motor, and "Regulex" exciters to vary generator output over a wide range. With increased possibilities for speed selection, the newly-designed tandem mill can produce steel of both higher and lower gauge thickness than was formerly possible — mill set-up time and kinds of stock needed are greatly reduced!

MORAL: You can get the added flexibility of a unit generator system on *your* tandem mill . . . by a simple changeover and the installation of modern "Regulex" exciters. And with "Regulex" control on the job, you can do without boosters in motor armature circuits.

You'll find countless other steel industry uses for accurate "Regulex" control—for reel control, on cleaning and tinning lines, on reversing blooming and slabbing mills, for arc furnace control, etc. For the full story on "Regulex" control, see our nearby sales office, or write ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN. 2096



ALLIS CHALMERS **REGULEX CONTROL** *"The Educated Generator"*



Works of The Ironton Fire Brick Co., Ironton, Ohio. Closely-controlled heat-treatment in gas-fired kilns produces "Ironton Steel" bricks shown here.

Ceramic engineer at The Ironton Fire Brick Co. sights L&N Optical Pyrometer through the kiln wall, to measure temperature of fire boxes.

BRICK MFR. HITS NEW STRIDE IN ECONOMY

As Optical Pyrometer Pays for Itself in 3 Months!

"In order to be economical and efficient in using by-product coke oven gas for burning our Kentucky Clay fire brick," commented the vice-president of The Ironton Fire Brick Co., "we must carefully control temperature in the kiln fire boxes. We're been using an L&N potentiometer-type Optical Pyrometer for several years in this work, with excellent results. It's significant that the instrument paid for itself the first three months — it saved over $185.00 by reducing gas consumption and eliminating overburned brick.

"We're interested in quality as well as economy, and this, too, calls for close control of firing. The easy-to-use, reliably accurate Optical is a big help in producing brick of uniform size and quality, with high refractoriness. And it's a rugged instrument, giving us good service under the most strenuous conditions."

L&N Optical Pyrometers can serve to advantage in many applications where hot-surface temperatures need to be measured quickly and conveniently. The instruments are supplied in several ranges, calibrated either in Fahrenheit or Centigrade. Send for our Catalog N-33D . . . or outline your particular problem and get the specific recommendation of an L&N engineer.

LEEDS & NORTHRUP COMPANY, 4942 STENTON AVE., PHILA. 44, PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl Ad N-33D-664(5)

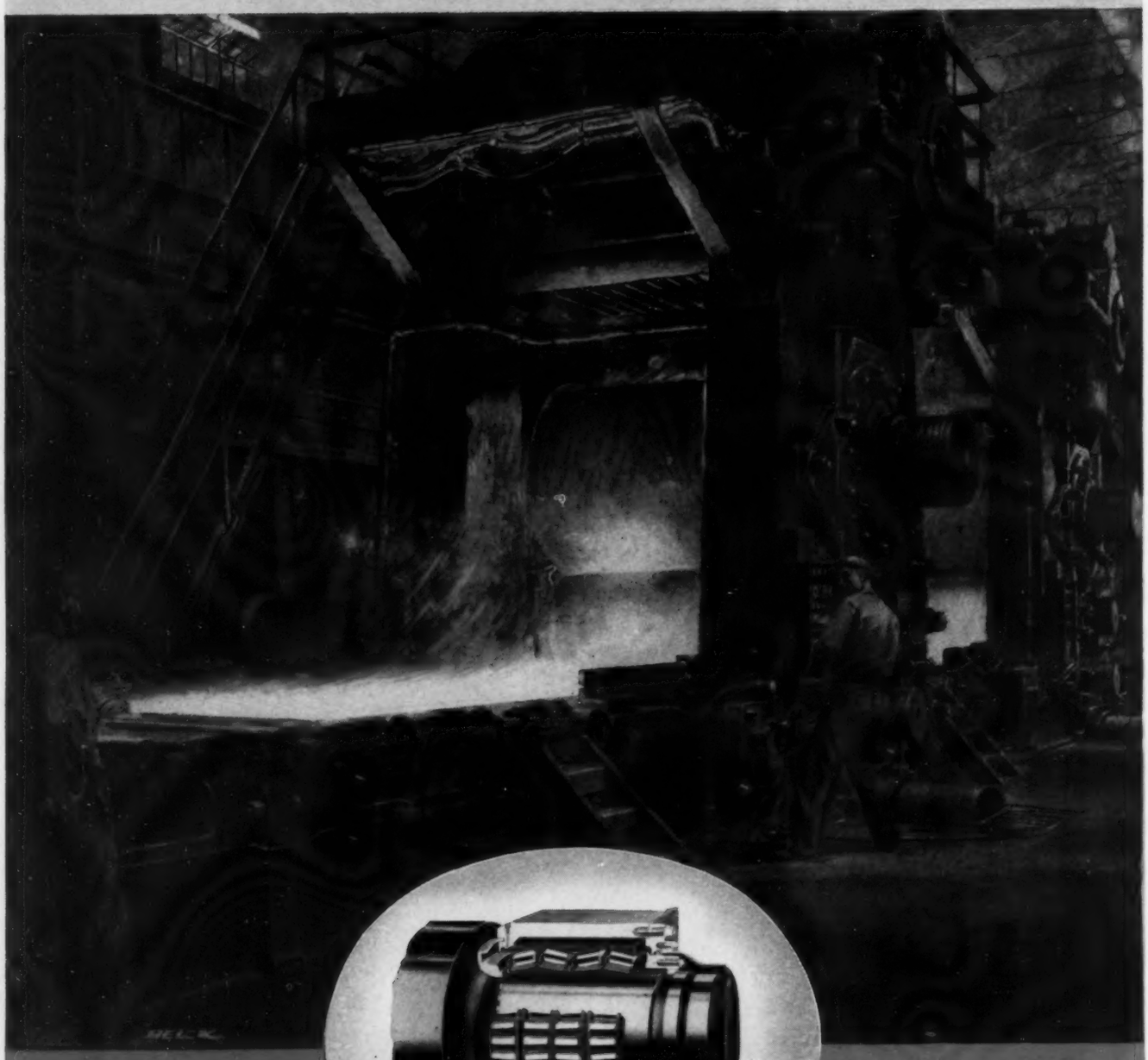
UNITED ENGINEERING AND FOUNDRY COMPANY
PITTSBURGH, PENNSYLVANIA

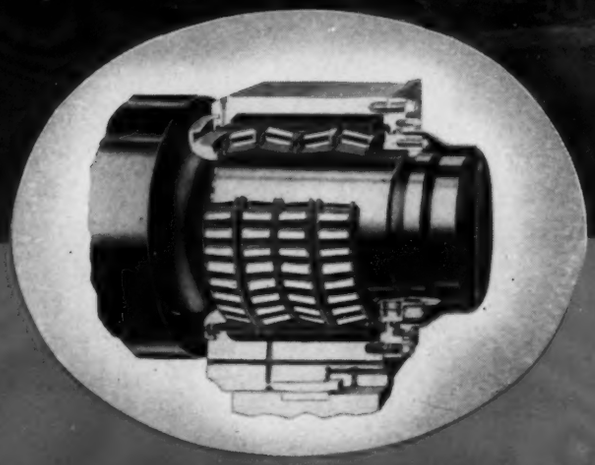
Plants at PITTSBURGH · VANDERGRIFT · NEW CASTLE · YOUNGSTOWN · CANTON
Davy and United Engineering Company, Ltd. Sheffield, England
Dominion Engineering Works, Ltd. Montreal, P. Q. Canada

TIMKEN "Balanced Proportion" STEEL MILL BEARINGS

FOR PRECISION, PRODUCTION AND ECONOMY

Show load ratings up to 40% higher than previous designs of tapered roller bearings, size for size, with 50% to 60% increase in neck strength, thereby assuring greater mill and bearing rigidity.





Painted in full color for The Timken Roller Bearing Company by Peter Helck.

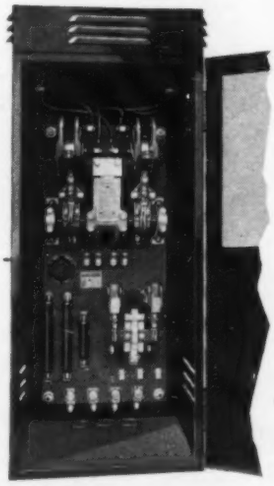
THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

Get a LIFT from LIFTING MAGNET Headquarters

- - with the All-Welded Circular LIFTING MAGNET

GREATER Lifting Capacity - Permanently Tight Construction

Two-Position Master Switch.



Adjustable type, Automatic-Discharge Magnet Controller for use on all magnets.

The EC&M Type SW **All-Welded** Lifting Magnet has many advantages because—

1. Welding eliminates the need for recesses for pole-shoe bolts in the magnet-housing and results in a better proportion of coil space and a more effective magnetic path.

2. There are no bolts to stretch and allow pole-shoes to loosen where rust, scale or foreign material can collect and prevent a snug refit. Neither are cored holes for bolt heads necessary in the pole-shoes. Instead, pole pieces are solid rings of metal drawn up tightly to the magnet-housing and held permanently by continuous welds.

3. The coil-case, containing high-temperature insulated, strap-copper winding, is a completely enclosed unit. This separate unit is preheated to drive out moisture, placed on its side and filled from the bottom with the new 282-compound. It is set by baking and will not melt nor become brittle, yet acts as a resilient cushion between winding and coil-case.

4. Placed in the magnet-housing, the inner circumference and outer edge of the coil-case rest against machined ledges. Continuous welds on these two circular edges form a watertight seal.

Type SW Lifting Magnets are available in five sizes for fast-handling of material in scrap yards, iron and steel plants, etc. Bulletin 900 completely illustrates, describes and gives operating data of these EC&M **All-Welded** Lifting Magnets. Write for a copy.

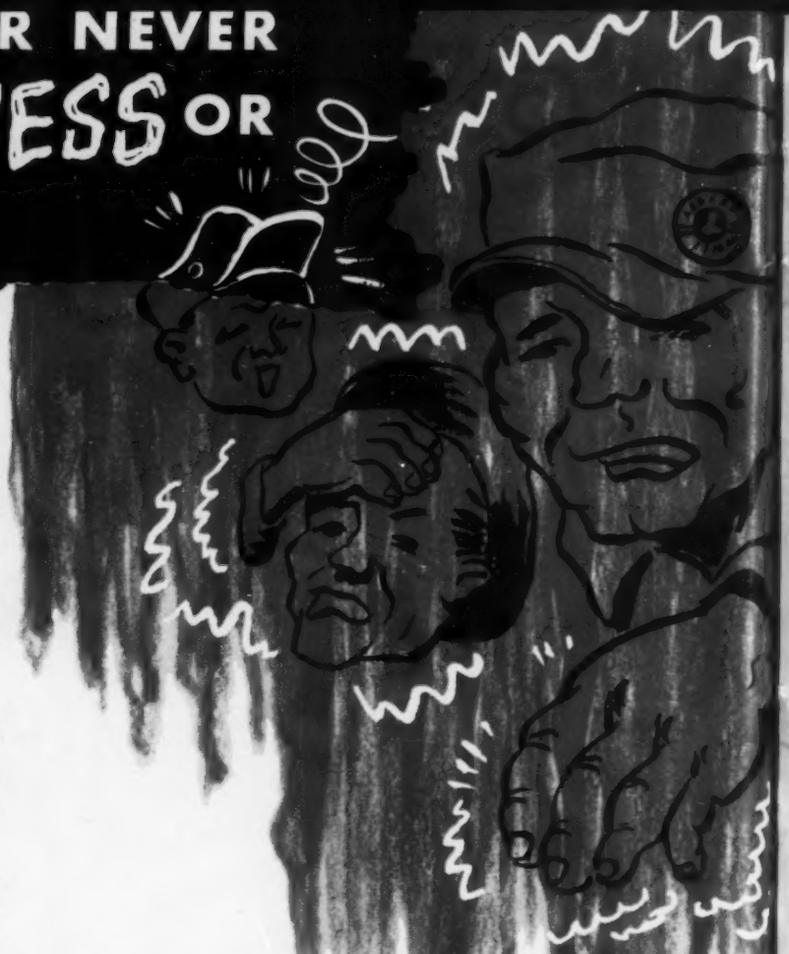
Type SW 39-inch diameter Lifting Magnet with full load of steel punchings.

Type SW 45-inch diameter Lifting Magnet handling car wheels.

THE ELECTRIC CONTROLLER & MANUFACTURING CO.

2600 E. 79th St. Cleveland 4, Ohio

THE BONNOT BILLETEER NEVER SUFFERS GROGGINESS OR JITTERS



Billet-shed production records confirm what safety men and industrial engineers know . . . that the efficiency of manual chippers and scarfers drops rapidly after a few hours work.

FATIGUE INCREASES YOUR COSTS

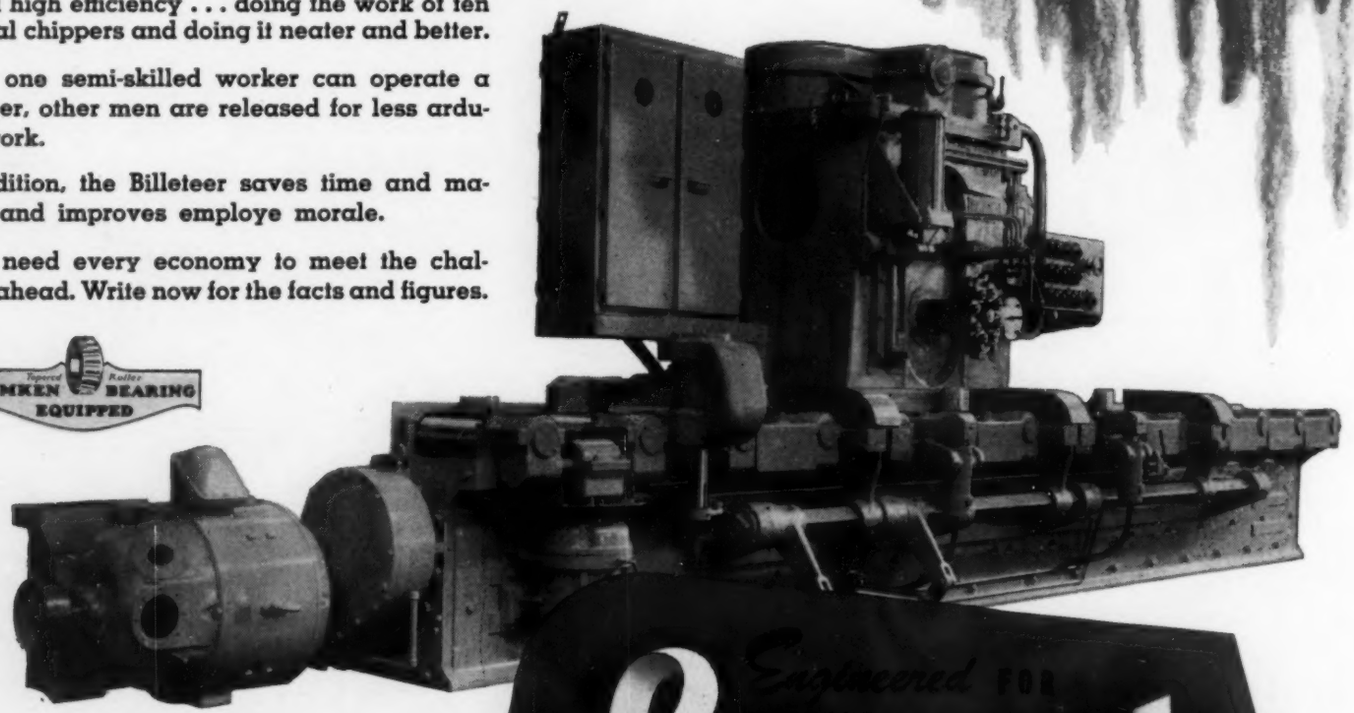
Human muscles and nerves cannot stand the strain of handling a chipping hammer or heavy scarfing torch hour after hour. Fatigue sets in, followed by grogginess and jitters. Despite everything, workers must slow down. Production suffers . . . costs go up.

Bonnot Billeteer-equipped billet-sheds are free from this bugbear of human fatigue. This modern machine never tires . . . works through one shift after another at sustained high efficiency . . . doing the work of ten manual chippers and doing it neater and better.

Since one semi-skilled worker can operate a Billeteer, other men are released for less arduous work.

In addition, the Billeteer saves time and material and improves employe morale.

You'll need every economy to meet the challenge ahead. Write now for the facts and figures.



Send for information

on other Bonnot machines engineered and manufactured to solve specific problems of the iron and steel industries.

BILLET INSPECTION TABLES
CHARGING TABLES • COLD SAWS
GRINDING PANS • CLAY MIXERS
CLAY FEEDERS, ETC.

Engineered FOR

Bonnot

THE BONNOT COMPANY

BUILDERS OF THE BILLETEER

CANTON 2, OHIO

ADDRESS
CORRESPONDENCE TO STEEL EQUIPMENT DIVISION

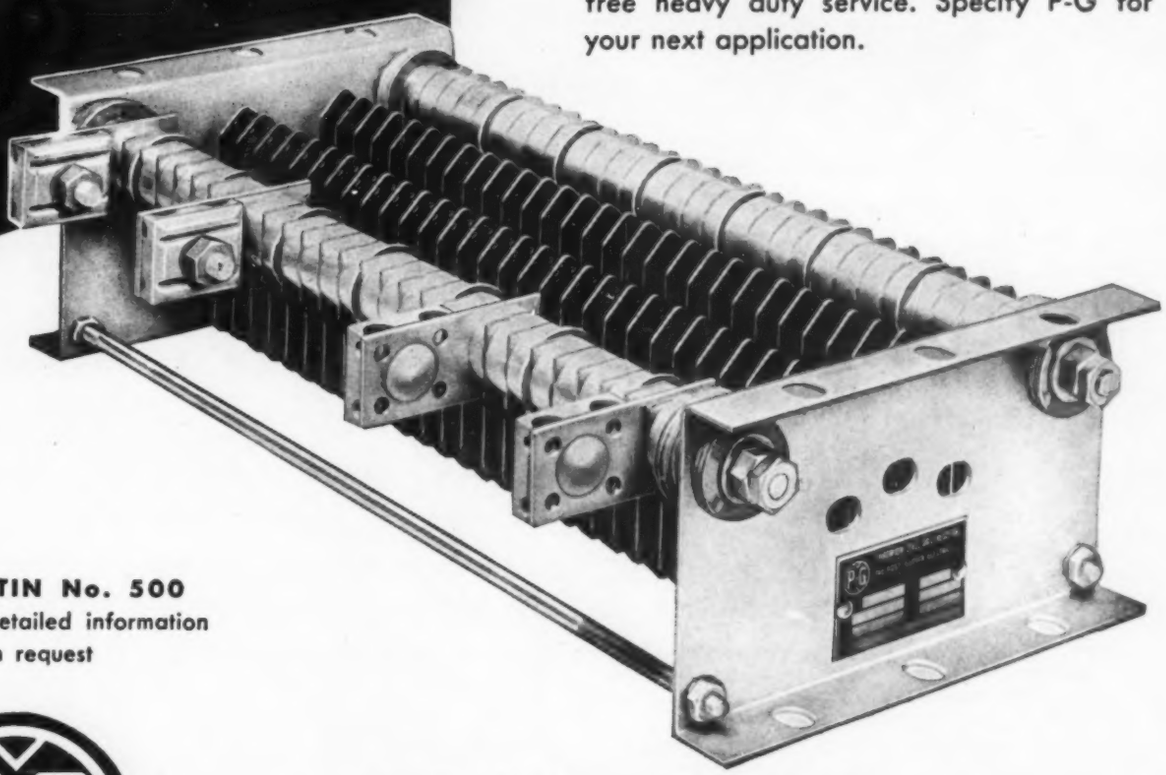
MEET *All* REQUIREMENTS

... *correct* OHMIC VALUES

... *plus* AMPLE CAPACITY

P-G *Steel Grid Resistors*

Use resistance grids punched from many gages of resistor steel. Thus it is easier for P-G to meet correct ohmic values and still furnish the capacities necessary for each job. Ability to meet both requirements is assurance of accurate control with full protection for your electrical equipment. All steel construction, mica insulation, with provision for expansion and ample ventilation give that extra stamina needed for trouble-free heavy duty service. Specify P-G for your next application.



BULLETIN No. 500
Gives detailed information
Copy on request

P-G

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

221 WEST THIRD STREET, CINCINNATI 2, OHIO

N·B·M Bronze Bearings Last 18 Times Longer UNDER THE IMPACT OF ROUGHING ROLLS

Structural roughing rolls like these are rough on bearings. They must operate 24 hours a day under dirt and mill scale, intense heat, staggering shocks.

N-B-M Bronze Bearings can take it. They last 10 to 18 times longer than conventional babbitted steel shells—by actual test. They also give you proportionate tonnage increases, substantial savings in power and maintenance costs, and new freedom from cut roll necks.

Consult an N-B-M bearing engineer now—it pays.

N • B • M

BRONZE AND COPPER CASTINGS

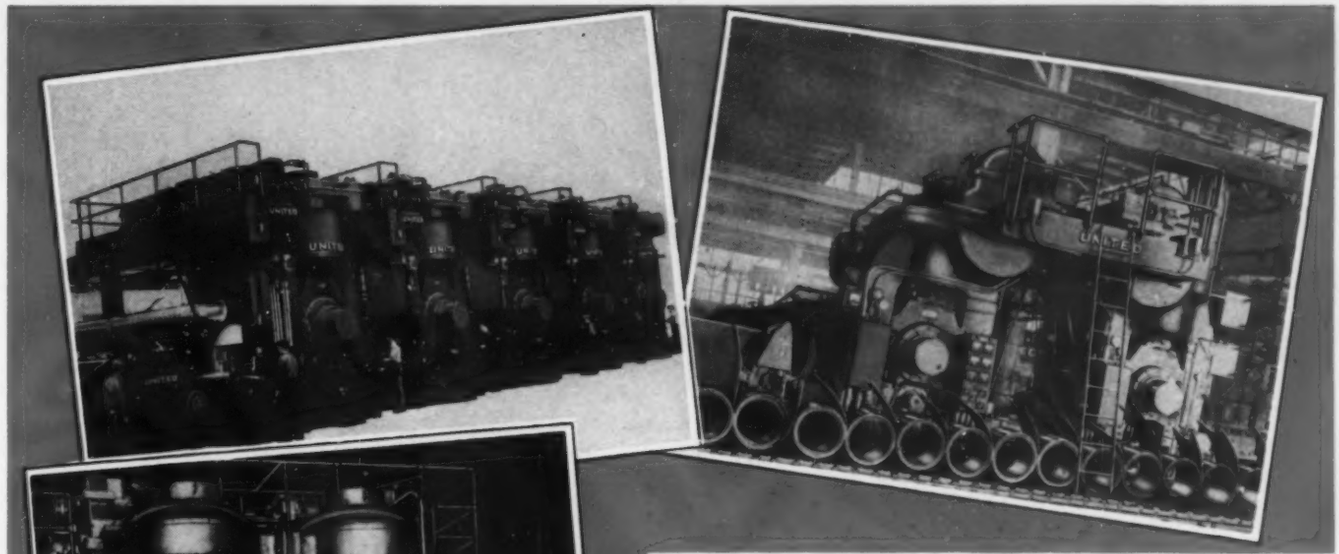
Blast Furnace Copper Castings • Roll Neck Bearings • Slippers
Housing Nuts • Machinery Castings • Babbitt
Metals • Acid Resisting Castings • Phosphorized Copper

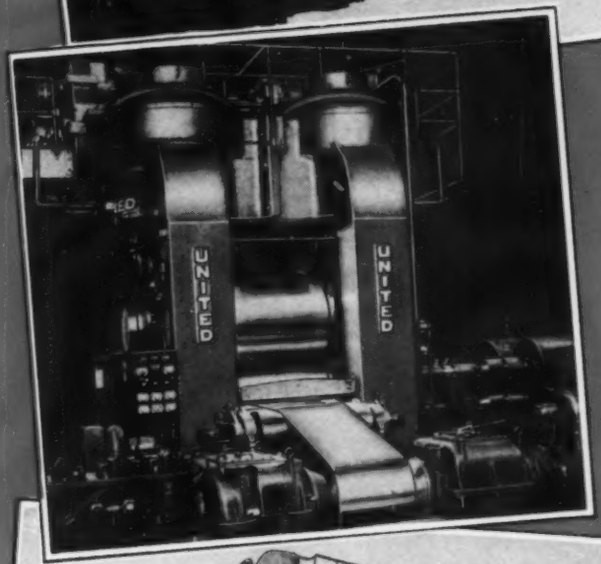
NBM

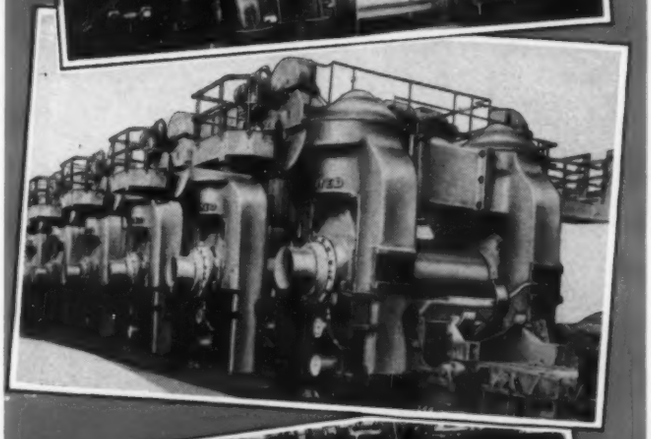
AMERICAN Brake Shoe COMPANY

NATIONAL BEARING DIVISION
PITTSBURGH • NEW YORK

PLANTS IN: ST. LOUIS, MO. • PITTSBURGH, PA. • MEADVILLE, PA. • JERSEY CITY, N. J. • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, ILL.







UNITED PRODUCTS

ROLLING MILLS

Blooming · Slabbing · Plate · Universal 2, 3, 4-high · 4-high Hot Strip · Bar · Rail and Structural · Merchant Rod · Sheet · Skelp · Pipe and Tube · 2 and 4-high Cold Strip · Tin · Uni-Temper.

IN ALL TYPES: Single Stand, One Way or Reversing, Tandem, Continuous, etc. For Carbon Steel, Alloy Steels, Copper, Brass, Aluminum and other Non-Ferrous Metals.

ROLLS

United "Regular Chill & Sand Iron" · United "Molybdenum Chill" · "United Special" Alloy Iron ("Unefco" Chill & Grain) · United "UX" · United "H. D." Iron · United "Unidense" · United "M. C." · United "Rail Finishing" · United "Special Process" · United "Nickel Chill" · United "Carbon Steel" · "United Special" Alloy Steel · United "Adamite" · United "D. U." · United "Van-X" · "United Special" Alloy Steel · United "Super-X".

AUXILIARY EQUIPMENT

Ingot Cars · Manipulators · Edgers · Mill Tables · Transfers · Hot Beds · Structural Straighteners · Bloom Shears · Vertical Shears · Hot and Cold Saws · Rod Reels · Hot Strip Reels · Flying Shears · Shearing Lines · Sitting and Trimming Lines · UNIDRAW—Continuous Draw Benches · Steam Hydraulic Forging Presses · Electro-Hydraulic Forging Presses · Electro-Hydraulic Piercing Presses · Hydraulic Presses · Universal Couplings · Welding Manipulators · Generated Gears and Pinions · Continuous Strip Picklers · Semi-Continuous Strip Picklers · Rotary Strip Picklers · Electrolytic Strip Cleaning Lines · Electrolytic Strip Tinning and Coating Lines · United Mill Lubricating Systems · Material Handling Equipment · Portable Crop Shears · Lever Shears · Roll Lathes · Pressuremeters · Heavy Weldments · Annealing Boxes · Steel Castings · Plate and Squaring Shears · Precision Levelers · Cone Type Uncoilers · Coil Boxes · Upcoilers & Downcoilers (Strip) · Cold Strip Reels · Cone Worm Drives · Gear Reduction Units.

UNITED ENGINEERING and FOUNDRY CO.

PITTSBURGH, PENNSYLVANIA

PLANTS AT PITTSBURGH—VANDERGRIFT—NEW CASTLE—YOUNGSTOWN—CANTON

SUBSIDIARY: ADAMSON UNITED COMPANY, AKRON, OHIO

AFFILIATES:

DAVY AND UNITED ENGINEERING COMPANY, LTD., SHEFFIELD, ENGLAND

DOMINION ENGINEERING WORKS, LTD., MONTREAL, P. Q. CANADA

PRECISION STRAIGHTENER

Here is a modern, accurately controlled machine that straightens cold alloy steel plate up to 1 in. thick and 160 in. wide (yield point of 130,000 lbs. p.s.i.) at roll surface speeds from 20 to 60 f.p.m. It also levels correspondingly heavier plates with lower yield points.

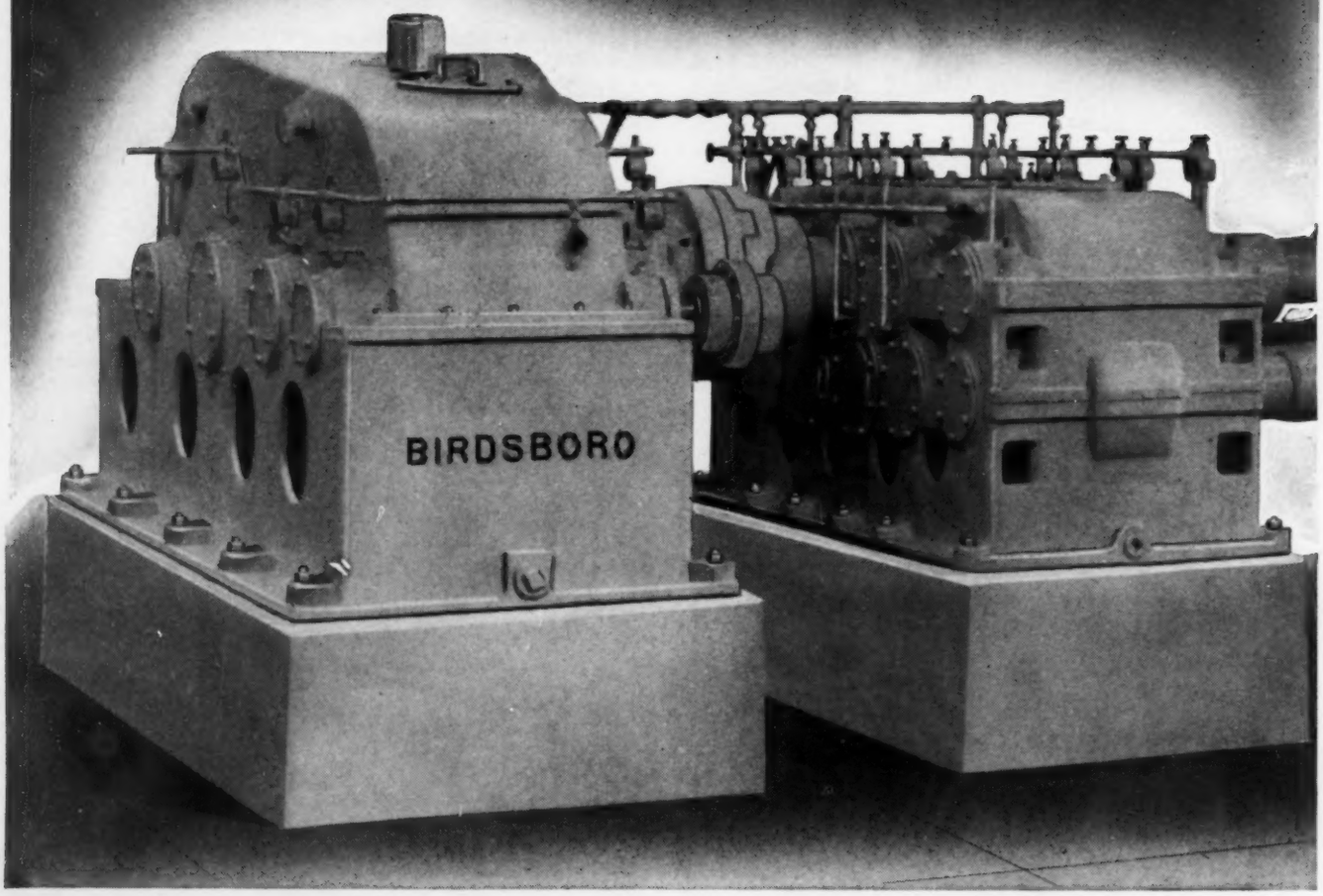
This machine has five work rolls, two feed rolls and a deflector roll—all of forged alloy steel with hardened and ground bodies. The top feed and working rolls are provided with individually motor operated screwdowns and are oil-hydraulically balanced. Anti-friction bearings are used throughout with the exception of the work rolls.

This is a completely integrated unit with totally enclosed drives and automatic oil and grease lubrication system. Here is added evidence of Birdsboro's ability to design, engineer and construct heavy duty machinery that helps maintain maximum production from your steel mill operations. Investigate Birdsboro's facilities for working closely with your engineering staff to solve your mill equipment problems.

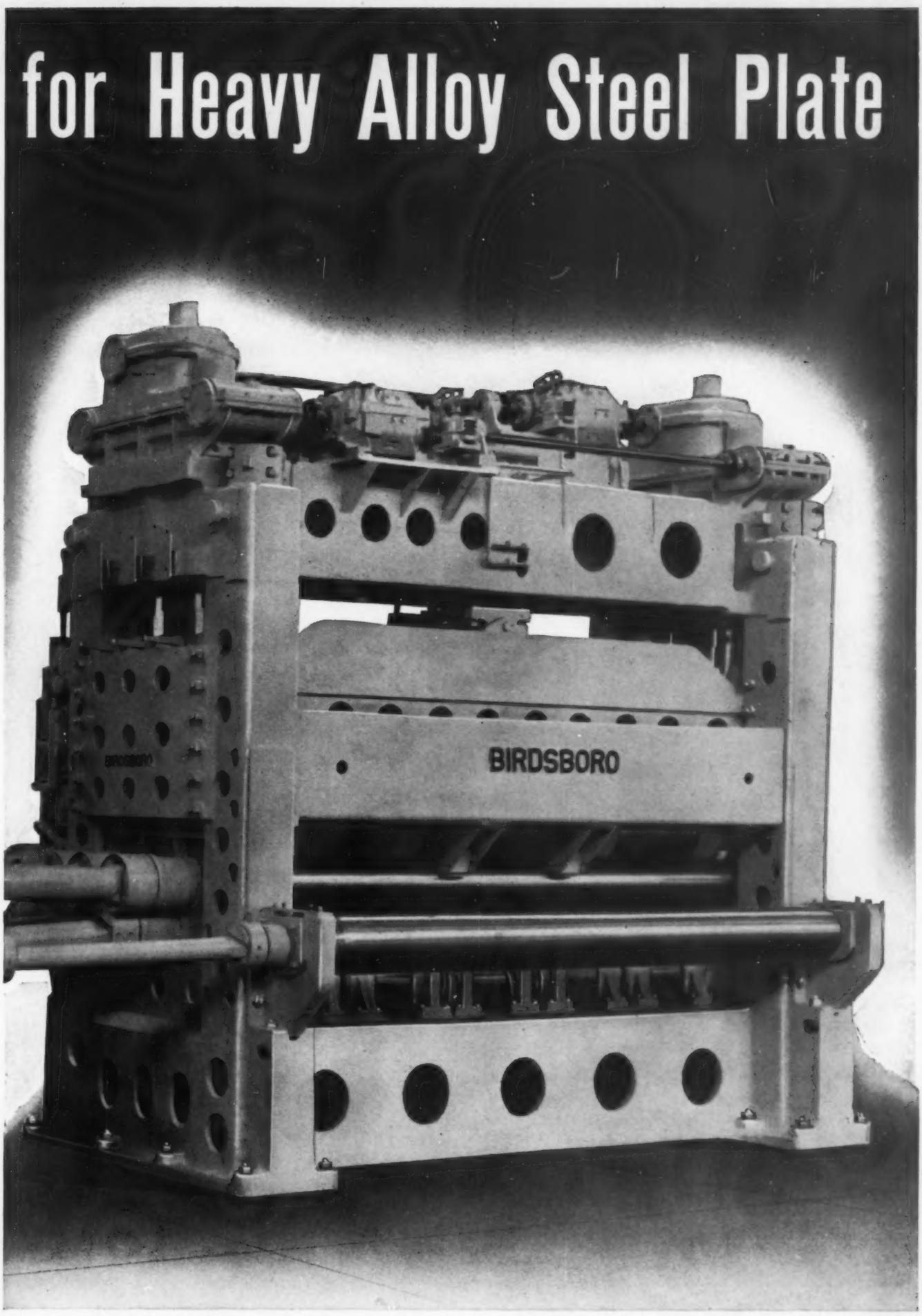
BUILDERS OF: Steel Mill Equipment • Hydraulic Presses • Rolls • Special Machinery • Crushing Machinery

BIRDSBORO STEEL FOUNDRY & MACHINE COMPANY • BIRDSBORO, PENNSYLVANIA

BIRDSBORO
STEEL MILL EQUIPMENT



for Heavy Alloy Steel Plate



¾ MILLION KVA of Pennsylvania Furnace Transformers *now in Service!*

YES, Pennsylvania Furnace Transformers, totaling ¾ Million KVA, are supplying power to hundreds of electric furnaces. The successful operation of these transformers has given Pennsylvania Transformer Company a noted reputation in the Furnace Transformer field. For over 30 years, Pennsylvania Engineers have closely followed the development of Electric Furnaces. They fully understand the problems of Electric Furnaces and their relation to Furnace Transformers.

SOME PROBLEMS OF DESIGN AND HOW THEY ARE MET

1. *Overloads.*

Electric Furnace operation inherently subjects Furnace Transformers to heavy overloads. To carry these overloads safely, a low temperature gradient must be maintained between copper and oil. Pennsylvania coils are designed so that a large surface of each wire in the high voltage and low voltage windings is directly exposed to the cooling oil. Large vertical ducts distribute the oil through the coils. Ducts are clear and unobstructed; hot spots cannot develop in the windings.

2. *Balancing of Stresses.*

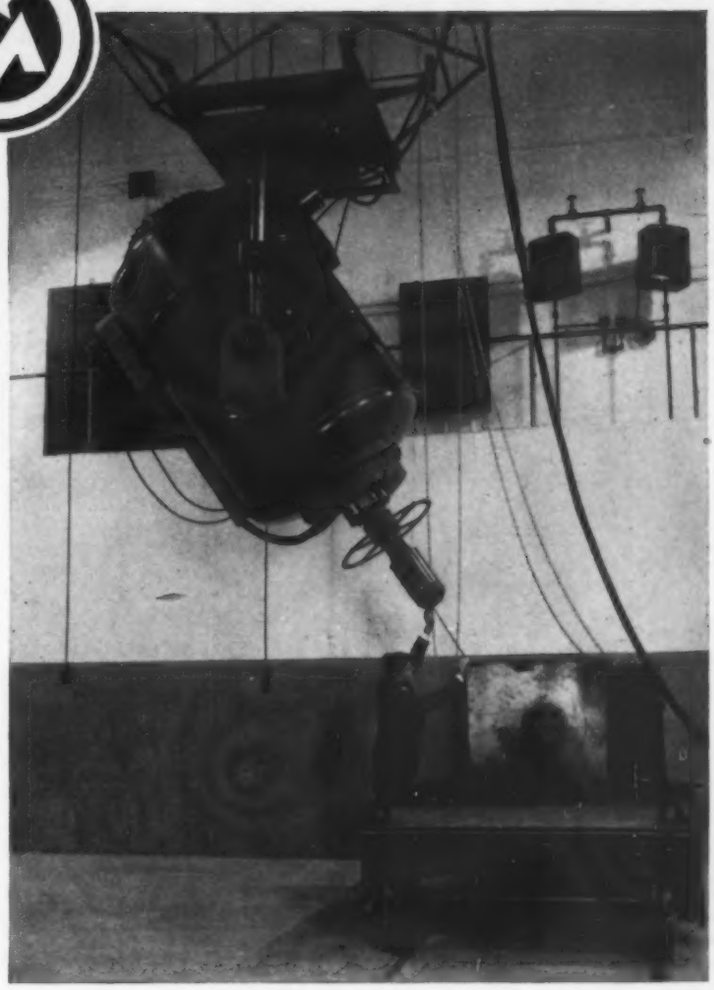
Pennsylvania coils are balanced to reduce the radial and axial short circuit stresses to a minimum. 1. The circular shape protects the coils against deformation due to radial short circuit forces. 2. The total axial short circuit force is calculated for each design and the coils are subjected to an equivalent pressure in a three hundred ton hydraulic press. The ability of the coils to maintain their shape, under the prescribed pressure, guarantees that the transformer will safely withstand short circuits.

3. *Distribution of Currents.*

Due to heavy secondary currents, the windings must be subdivided into numerous parallel sections. A skillful arrangement of the windings insures that each section carries an equal share of the current. Careful transposition of the individual conductors of each section in the windings reduces the copper eddy losses to a minimum. This results in improved efficiency, more uniform copper temperature and prevention of hot spots.

Pennsylvania TRANSFORMER COMPANY — Pennsylvania TRANSFORMERS — *Furnace Transformer Experts* — PITTSBURGH, PENNSYLVANIA

OUR 2,000,000 VOLT ELECTRIC EYE



MIDVALE'S 2,000,000 volt X-ray tube is the only one of its size in use in any steel mill—a distinction indicating Midvale progressiveness, and soundness of inspection methods. This powerful eye pierces steel 12 inches thick . . . pictures the interiors of forgings, castings and other products . . . points out faults or perfection. And does it faster and surer than equipment of lesser voltage. You can lower the cost of your products—prove their quality and design—by *non-destructive* inspection, with Midvale's penetrating 2,000,000 volt X-ray eye.

THE MIDVALE COMPANY • NICETOWN • PHILADELPHIA

OFFICES: NEW YORK • CHICAGO • PITTSBURGH
WASHINGTON • CLEVELAND • SAN FRANCISCO

MIDVALE
Custom Steel Makers to Industry

STAINLESS AND TOOL STEEL BARS
•
CORROSION AND HEAT RESISTING CASTINGS
•
FORGINGS AND RINGS

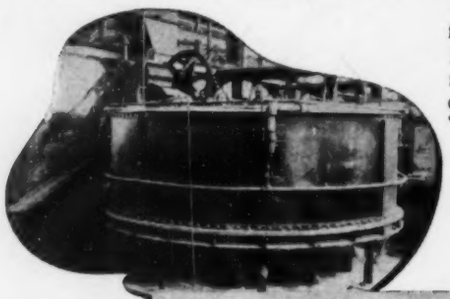
Advertisement JANUARY, 1947

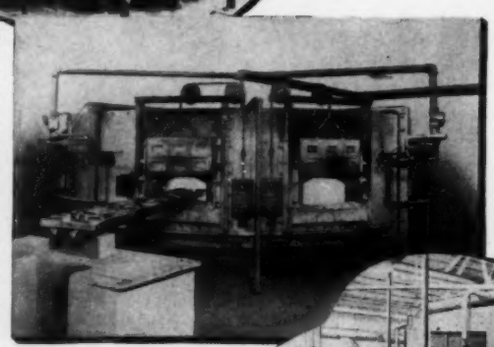
R-S FURNACE FACTS

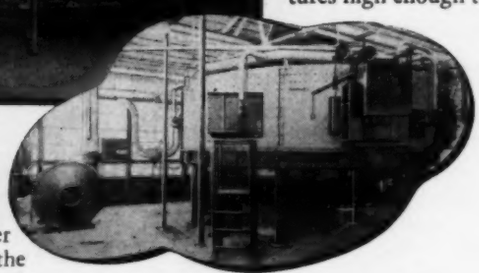
ISSUED MONTHLY BY R-S PRODUCTS CORPORATION, PHILADELPHIA 44, PA., FOR THOSE CONCERNED WITH QUALITY HEATING OF METALS

. . . AND THE BILLETS GO 'ROUND-AND-'ROUND

Few problems in furnace engineering test the designer more than *rotary-furnace hearth construction.* The weights of the hearths, their large dimensions, and the lengths of their circumferences—traveling at close clearance within stationary shells — all contribute in breeding two main types of trouble under heat: (1) jerkiness and play in the drive, and (2) jamming and friction along the hearth rim.







That is, unless the builder is an old hand at rotary furnace design!

R-S has been building rotaries for over 23 years. Consider four typical jobs, the work they do, and their service records.

At the left of the illustration is a little doughnut-type, 8'6" in diameter at the rim with a 5'6" hole. It dates back to 1923; it hardens bolts and nuts (continuously fed to and removed from the hearth) at 1650 to 1700°F; it's oil fired.

Not shown is a big one of similar design, 30' in diameter, installed in 1928 and operated at high heat without hearth expansion or warpage troubles.

The center unit is a new one; gas-fired; operating above 2000°F; and with 3 zones of control to pace the heating rate. It's used by one of our major steel companies in forging billets of a special "tender" alloy. It's 15'9" across the hearth.

At the right is another old timer; oil-fired; heating big wheel billets at 2200°F; measuring 14'9"; and chalking up an even 20-year record of trouble-free duty this winter.

More than ordinary mechanical skill is required to build such ton-heavy merry-go-rounds, which neither bind nor stutter nor crack under bruising continuous operation at chamber temperatures high enough to make steel drip. It takes more than a B.S. degree to predict strengths and clearances in large moving structures under persistent heat and load.

And that's why big rotaries are first-magnitude R-S business!

FURNACE BUYER'S NEW YEAR RESOLUTION

I shall study each furnace bid twice.
I shall stand for no skimping—cur slice
Cut the features I need
For control, life and speed.
I shall see what is there—besides price!

BUY WITH AN EYE TO MAINTENANCE COSTS

According to the editors of Iron and Steel Daily News, AISE publication, over 8 cents of every steel industry dollar goes into maintenance of plant and equipment—three times the amount of that industry's earnings. Further, this "cost of maintenance" is rising: $4.56 per cast ton in 1940, versus $5.40 in 1942, versus $6.02 in 1944.

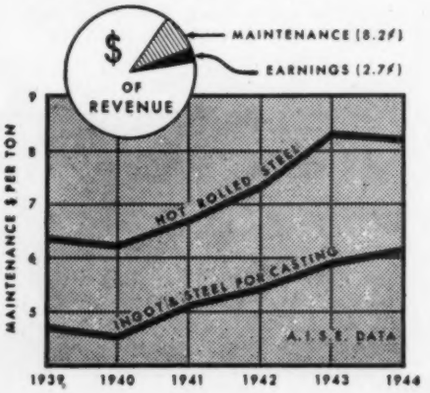
Think of this alarming trend in terms of your furnaces.

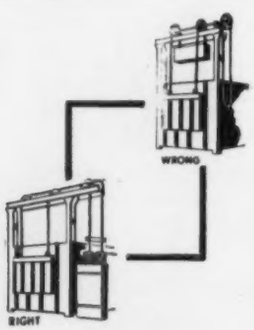
If you've bought with an eye to long life and simple operation—if you've had your furnaces designed by engineers who know the little quirks that count* and think of the men who run your plant**—you're saving real money for your company.

Apparently we're right at R-S in making so much of maintenance details like: expansion joint design, proper air and oil leads to burners, segmented conveyor slats, and better door counterweighting (see item at lower left).

Customers' records demonstrate that R-S designs trim down that 8.2 cents of upkeep per revenue dollar.

*See FURNACE FACTS, September, 1946.
**See FURNACE FACTS, October, 1946.





MORE ON R-S "DESIGN-CARE"

There are two ways to counterweight a heavy furnace door (see sketches). Careless engineers looking for the easiest way out often suspend counterweights right over the arch. Not so at R-S. We have too much regard for our furnaces and your maintenance costs. Lift chains or door fastenings might fail, and let the counterweights crash down onto the brickwork.

At R-S we take the pains to run all chains to the side, and to house all weights. If they drop, it's a thump—that's all!

JMLco-P-A1

Continental

Industry's Major Source for

ROLL LATHES

Check first with

Continental

FOUNDRY & MACHINE CO.

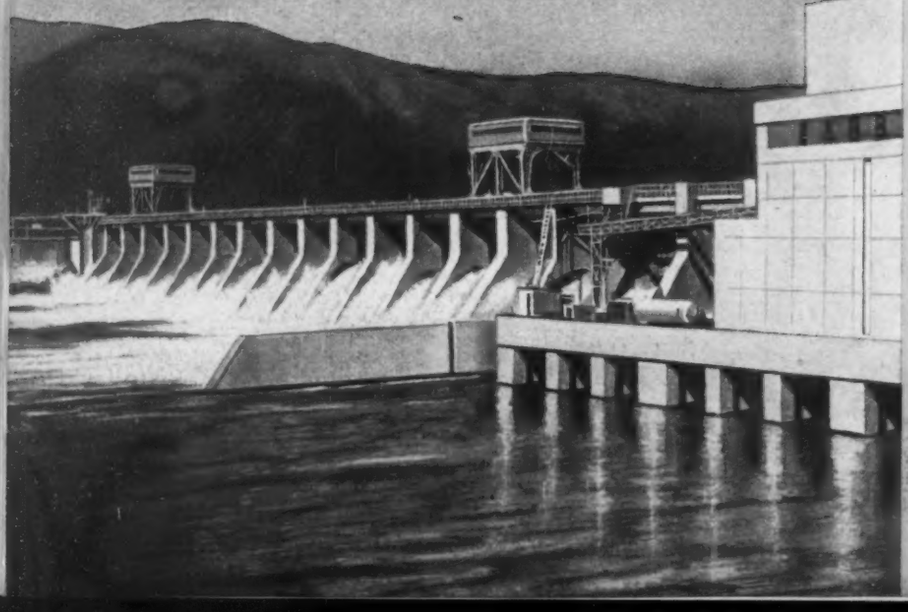
CHICAGO · PITTSBURGH

Plants at:

East Chicago, Ind. · Wheeling, W. Va. · Pittsburgh, Pa.

62,000 Continental Castings

FOR GIANT HYDRO-ELECTRIC OPERATION



Outstanding skill in research, design, engineering and manufacture is available for ordinary *"production line"* 50 pound castings up to difficult, unusual castings that weigh as much as 250,000 pounds.

When you need Steel Castings of any type *—call on Continental.*

Continental

FOUNDRY & MACHINE CO.

CHICAGO • PITTSBURGH

Plants at: E. Chicago, Ind. • Wheeling, W. Va. • Pittsburgh, Pa.

THIS "Buffalo" EXHAUSTER HAS A "STOMACH" FOR FUMES

- **RUBBER-LINED**
- **PERFECTLY BALANCED ROTOR**
- **A LONG-TERM MONEY-SAVER**
- **OUTLASTS ORDINARY EXHAUSTERS 3 TO 13 TIMES**

There's no magic connected with the durability of "Buffalo" Rubber-Lined Exhausters on jobs where highly corrosive fumes are being eliminated. Those fumes eat away metal rotors and housings in short order, calling for frequent and expensive replacements . . . but not when the exhauster has a rubber lining. You'll find, as so many "Buffalo" users have found, that these exhausters will save you many fume-handling dollars.

And the 67 years of Buffalo fan engineering experience add more savings yet through air handling efficiency. Why not write us for complete details and recommendations on your fume handling problem?

BUFFALO FORGE COMPANY

173 Mortimer Street Buffalo, N. Y

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

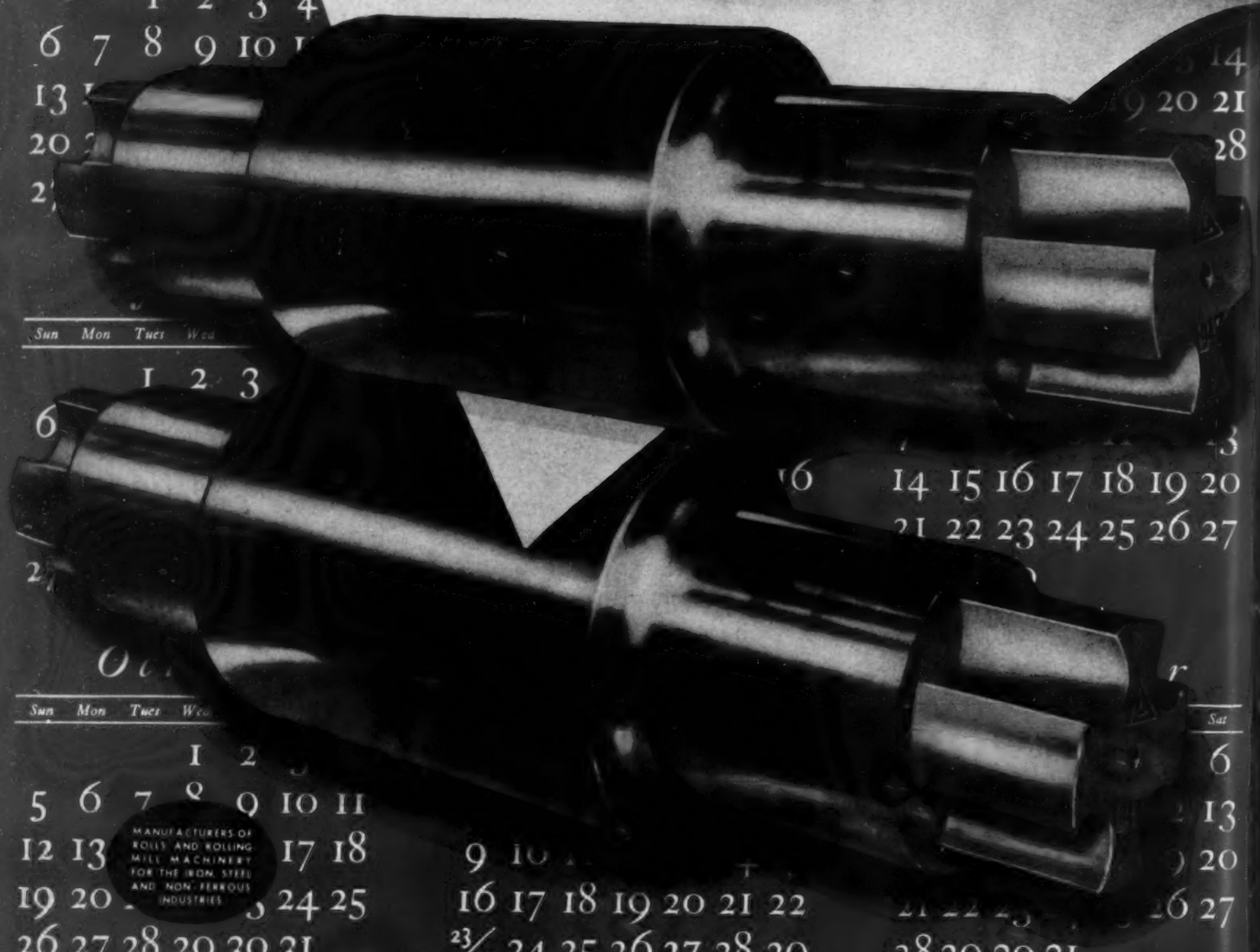
"Buffalo"

RUBBER-LINED EXHAUSTERS

The World Needs Rolled Metals

Production is going to determine your share of the market this year . . . and volume will be higher in mills where metals are rolled with Lewis Rolls at LESS COST PER TON.

LEWIS FOUNDRY AND MACHINE
DIVISION OF BLAW-KNOX COMPANY
PITTSBURGH, PA.



MANUFACTURERS OF ROLLS AND ROLLING MILL MACHINERY FOR THE IRON, STEEL AND NON-FERROUS INDUSTRIES

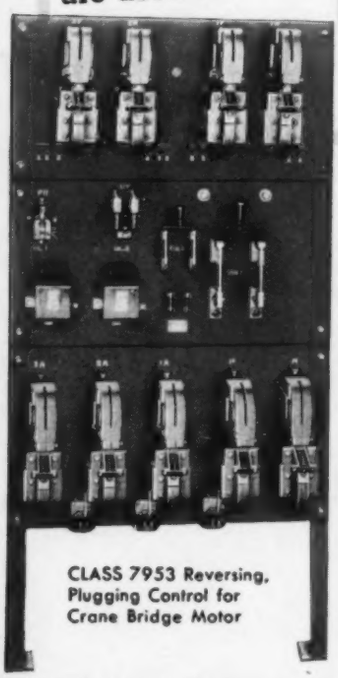
LEWIS ROLLS

New Mill-Type MASTER SWITCH

AVAILABLE IN 1 TO 6 POINTS—*Reversing or Non-Reversing*

• Specifications for Square D's new Class 9003, Type AD master switch originated with Mill Engineers. Ordinary construction is not suitable for mill duty where production delays cannot be tolerated and maintenance must be kept at a minimum in spite of severe service. Compare these features with those of other master switches you have used.

Square D also builds the control with which master switches are used . . .



CLASS 7953 Reversing, Plugging Control for Crane Bridge Motor

Stationary contacts with accessible solderless connectors mounted on slate board.

Movable contacts are double-break, silver, spring-closed, mechanically opened and are easily removed from guides by pressing down and turning 90°.

Sturdy handle has "OFF" position latch and padlock feature. Offset construction available for grouping 3 or 4 units. Feel of all positions is positive, with 24° *double travel* from "OFF" to first point in both directions.

Terminal board support serves as guide to prevent accidental damage when cover is replaced.

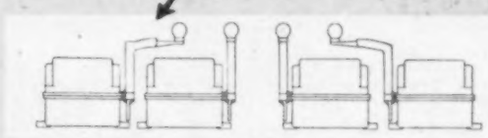
Dust-tight enclosure—split at bearing line for easy maintenance—has shallow box, deep cover and liberal space for internal wiring.

Conduit entrances are 1¼", conveniently located and have sufficient boss for redrilling and tapping to 1½".

Hardened cam shaft has *needle bearings*. Bakelite cams are bolted in position. Complete assembly has unusually wide electrical clearances and can be removed as unit.

Hardened star wheel and roller. Return spring pressure is adjustable.

Straight and offset handles combine to permit grouping of 3 or 4 units with 7" handle centers.



Write for information on CLASS 7950 SERIES Heavy Duty D.C. Control for Cranes and Mill Auxiliaries and CLASS 9003 Type Master Switches. Square D Company, 4041 N. Richards St., Milwaukee 12, Wisconsin.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

HAIRPIN PICKLING HOOK used in prominent steel plant for handling wire coils. Fabricated from standard mill forms of Monel by The Youngstown Welding & Engineering Company, Youngstown, O., this lightweight hook is ideal for heavy-duty service.

DESIGNED FOR LONG LIFE

Now you can have a lightweight pickling hook! One that's as strong as any you've ever used. One that's more corrosion-resistant than many heavier hooks. One that's designed for real economy.

Made of Monel* by **The Youngstown Welding & Engineering Company**, Youngstown, Ohio, the streamlined pickling hook illustrated here handles a 3000-pound load easily . . . and with enduring safety.

Monel resists the corrosive action of hot pickling acids. It has the high strength and toughness required by equipment that is subject to strain and stress. Monel hooks last despite bumps and jolts that fracture less ductile metals.

When balky, old-fashioned equipment stalls production or requires costly maintenance, there's a good chance that Youngstown can suggest an improved, lightweight design in Monel to meet your needs.

Why not write them — or us — for further information about economical, trouble-free pickling equipment? *Reg. U. S. Pat. Off.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK 5, N.Y.

MONEL... ONE OF THE INCO NICKEL ALLOYS

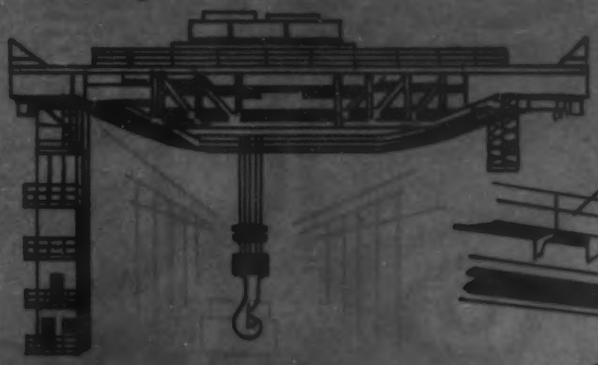
World's Largest Builder of the World's Largest Cranes

Alliance

Alliance makes the equipment to move slabs, ingots, hot metal, raw material and finished products safely, quickly, and easily.

For 50-odd years, Alliance has been known as The World's Largest Builders of the World's Largest Cranes.

GANTRY CRANE



LADLE CRANE

STRIPPER CRANE

SOAKING PIT CRANE

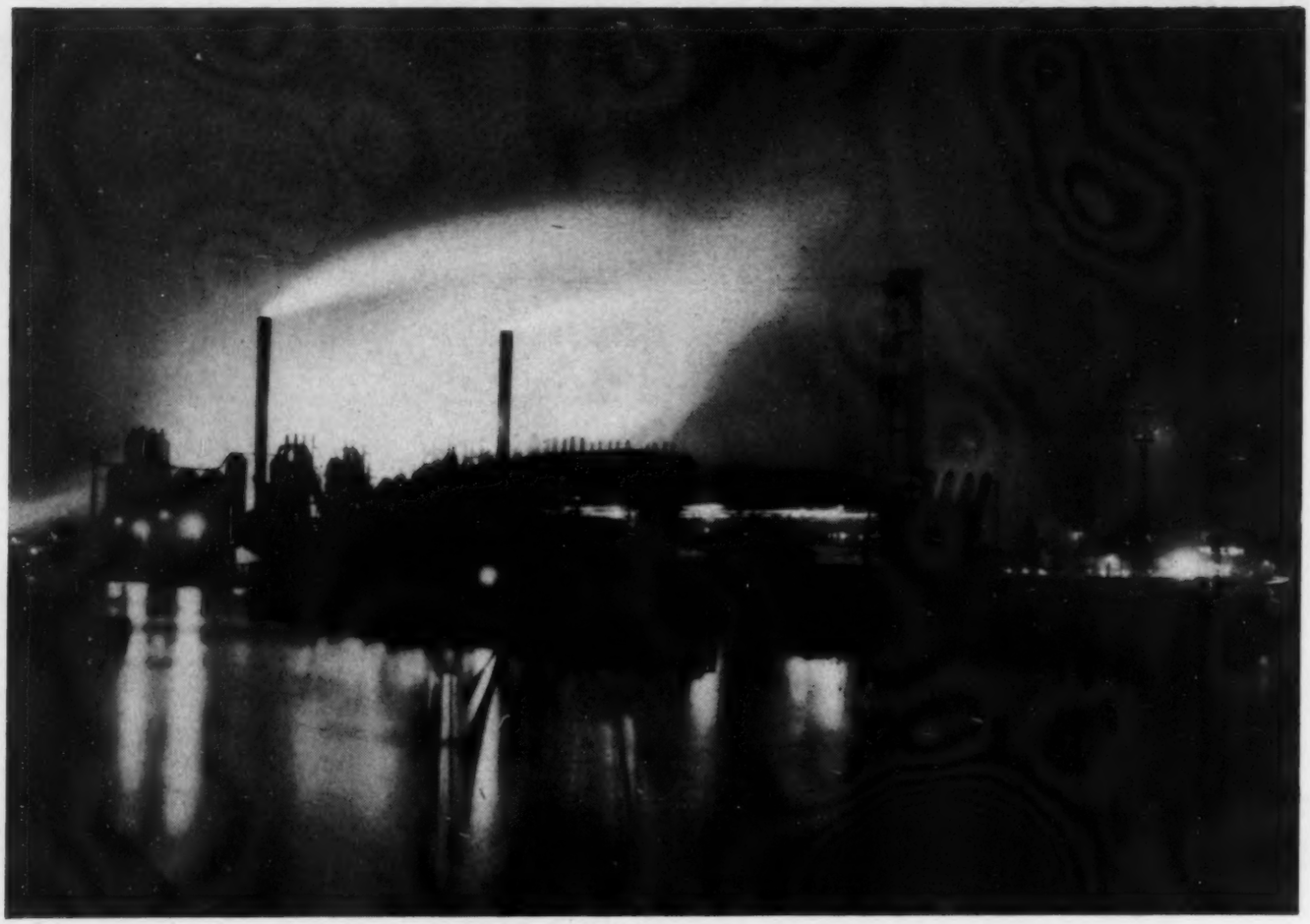
OPEN HEARTH CHARGING MACHINE

FORGING MANIPULATORS

SLAB AND BILLET CHARGING MACHINE

THE ALLIANCE MACHINE COMPANY

ALLIANCE, OHIO · 1622 OLIVER BLDG., PITTSBURGH, PA.



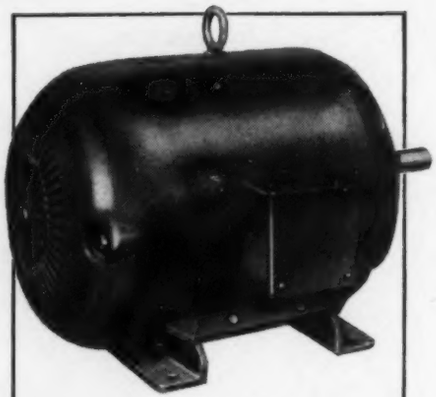
DUST and DIRT CAN'T HURT WAGNER *cp* MOTORS*

Totally-Enclosed Fan-Cooled Motors are SEALED against Harm . . .

THEY'RE built to take it . . . They're protected against dust, dirt, grit, steel chips, abrasives, and other destructive elements that would tear the heart out of ordinary motors. That's why you find thousands of Wagner totally-enclosed fan-cooled motors giving dependable service day after day, year after year, doing the dirty jobs in industry without asking favors.

If you use motors, it will pay you to investigate Wagner—A complete line . . . built by engineers who know how to build quality motors that will help you maintain peak production. Users of Wagner motors also profit by our quick, convenient, nationwide service facilities.

Contact any of our twenty-nine branch offices, located in principal cities and manned by trained field engineers ready to give you advice on all of your motor problems. Bulletins on the complete line of quality motors will be sent upon request. Address Wagner Electric Corporation, 6483 Plymouth Avenue, St. Louis 14, Mo.



Pictured above is a Wagner totally-enclosed fan-cooled motor. Wagner makes a complete range of motors for every application.

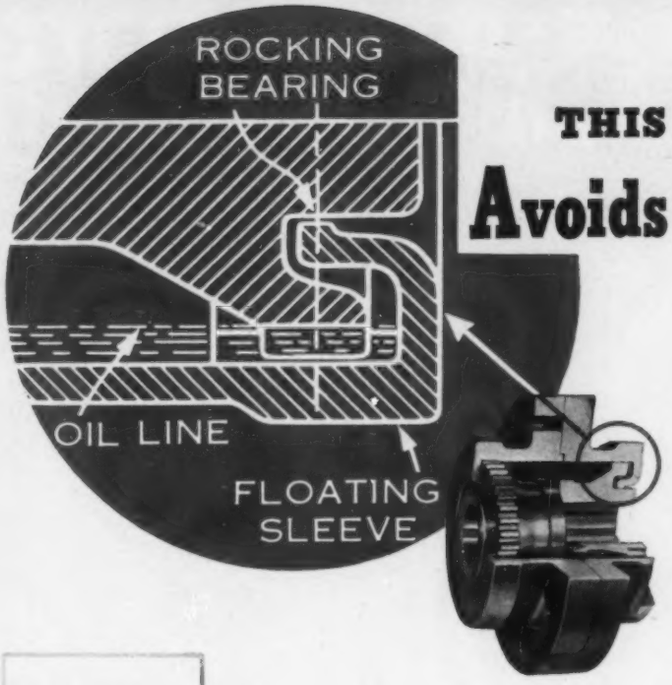
M47-8

Wagner Electric Corporation EST. 1891

Consult Wagner Engineers on all Electric Motor Problems

BRIDGE BRAKES • POWER AND DISTRIBUTION TRANSFORMERS • MOTORS • UNIT SUBSTATIONS

ELECTRICAL AND AUTOMOTIVE PRODUCTS

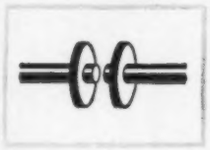


THIS METAL-TO-METAL SEAL

Avoids Coupling Shutdowns!

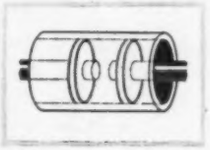
Fast's Couplings Have No Flexible Materials, Give Continuous Service

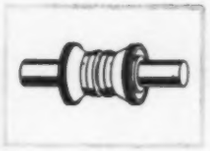
That's right! There are *no* perishable parts in a Fast's Coupling. Nothing to wear. No parts to be replaced. Even the load-carrying oil is guarded by a positive *metal-to-metal* seal. This *exclusive* "rocking bearing" (shown at left) keeps the oil free of moisture, dust, flying grit without use of perishable oil-retaining rings. Result: no shutdowns due to wear from dirt, abrasives or other foreign materials in oil.

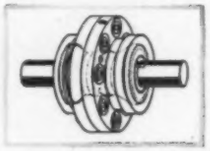


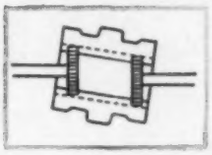
Fast's Couplings Are Simple As A-B-C

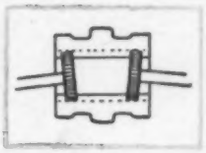
See the simple development of Fast's Couplings. A splined hub on each shaft end, a sleeve with internal splines to mesh. Oil in the sleeve carries the load between the splines.

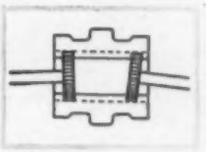












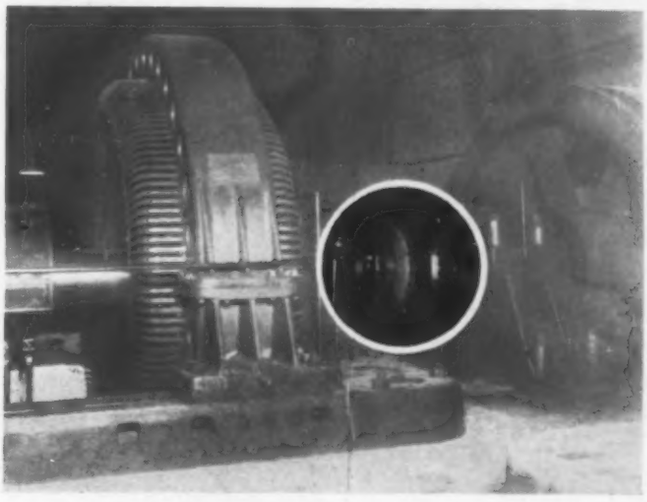
Fast's Couplings Compensate for All Misalignment

The floating sleeve takes a neutral position. All forms of misalignment are compensated for between the lubricated faces of the splines, equally divided between the driving and driven members. The entire assembly revolves as one unit.

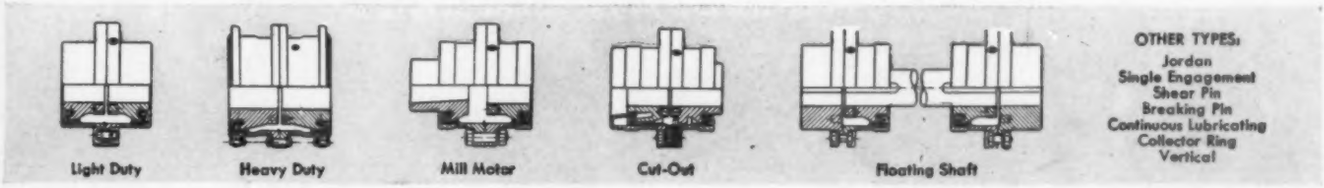
WRITE TODAY for our complete catalog, containing valuable information on Fast's self-aligning Couplings for practically every power transmission condition met in industry. It will help you lengthen the life of your machines, reduce upkeep costs, cut shutdown losses. Koppers Company Inc., Fast's Coupling Dept., 211 Scott Street., Baltimore 3, Maryland.

K
KOPPERS

FAST'S *self-aligning* COUPLINGS



Transmitting 3,000 H. P. at 135 RPM is this No. 18 Fast's Coupling between motor and flywheel set for billet mill drive at Pittsburgh Crucible Steel Co., Midland, Pa.



Continuous ANNEALING

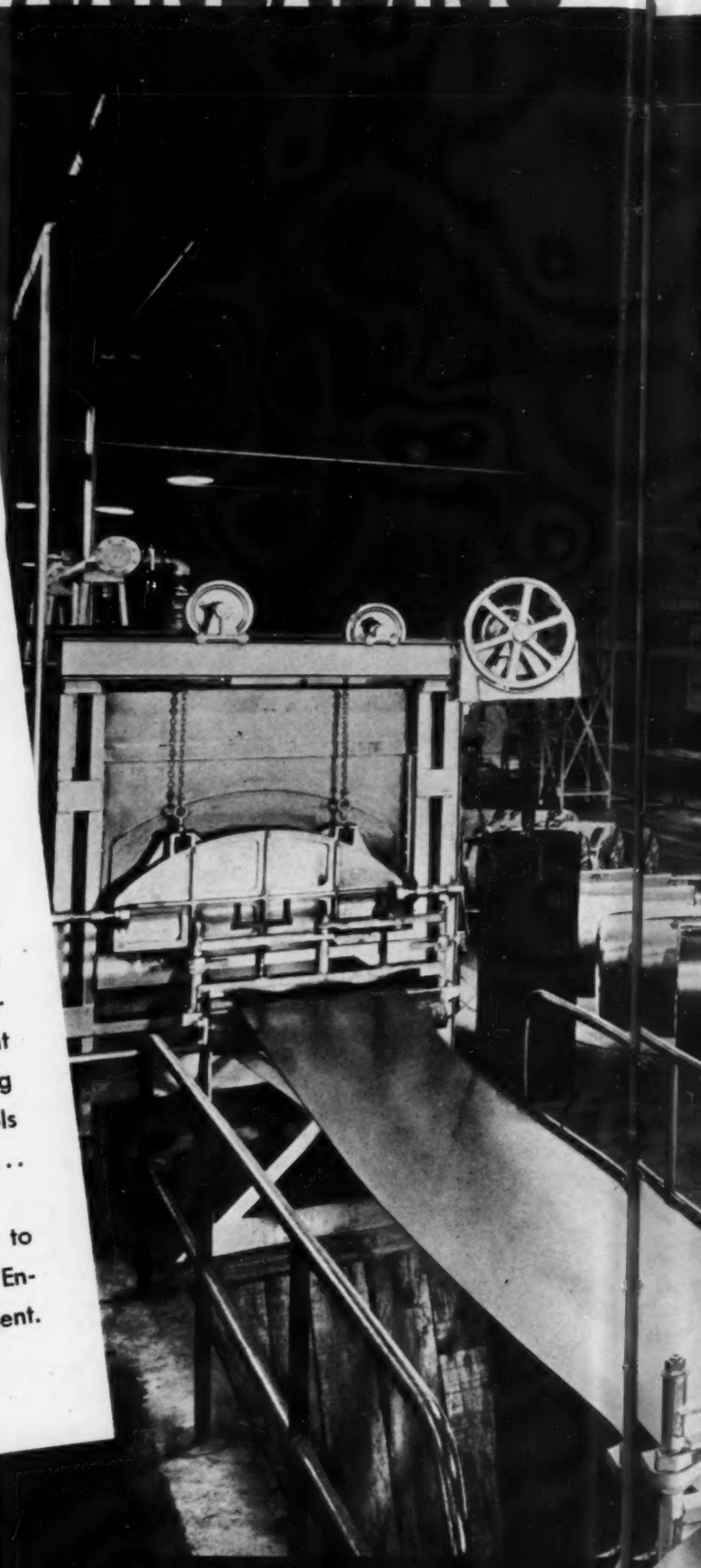
"Surface" Roller Hearth Furnaces utilize Radiant Tube Heating and Controlled Atmospheres to provide a bright metal surface.

For many years "Surface" Radiant Tube Heating and "Surface" Prepared Gas Atmospheres have been the choice of the steel industry for the heat treatment of strip, sheet, rod and wire.

In the accompanying illustration the continuous-type Strip Annealing and Normalizing furnaces were designed for quality and quantity production. The complete heat treating cycle . . . heating, cooling and quenching takes place within each furnace, in successive steps, providing for close operating control.

Whatever the production requirement—continuous or batch operation, "Surface" has many modern developments including the Radiant Tube and a broad background of research in the Science of Gas Chemistry and Heat Treating, to apply to the engineering of advanced heating and heat treating equipment for the specific job. With improved handling mechanisms, all these combined scientific tools have resulted in closer metallurgical control . . . greater capacities, and increased tonnage.

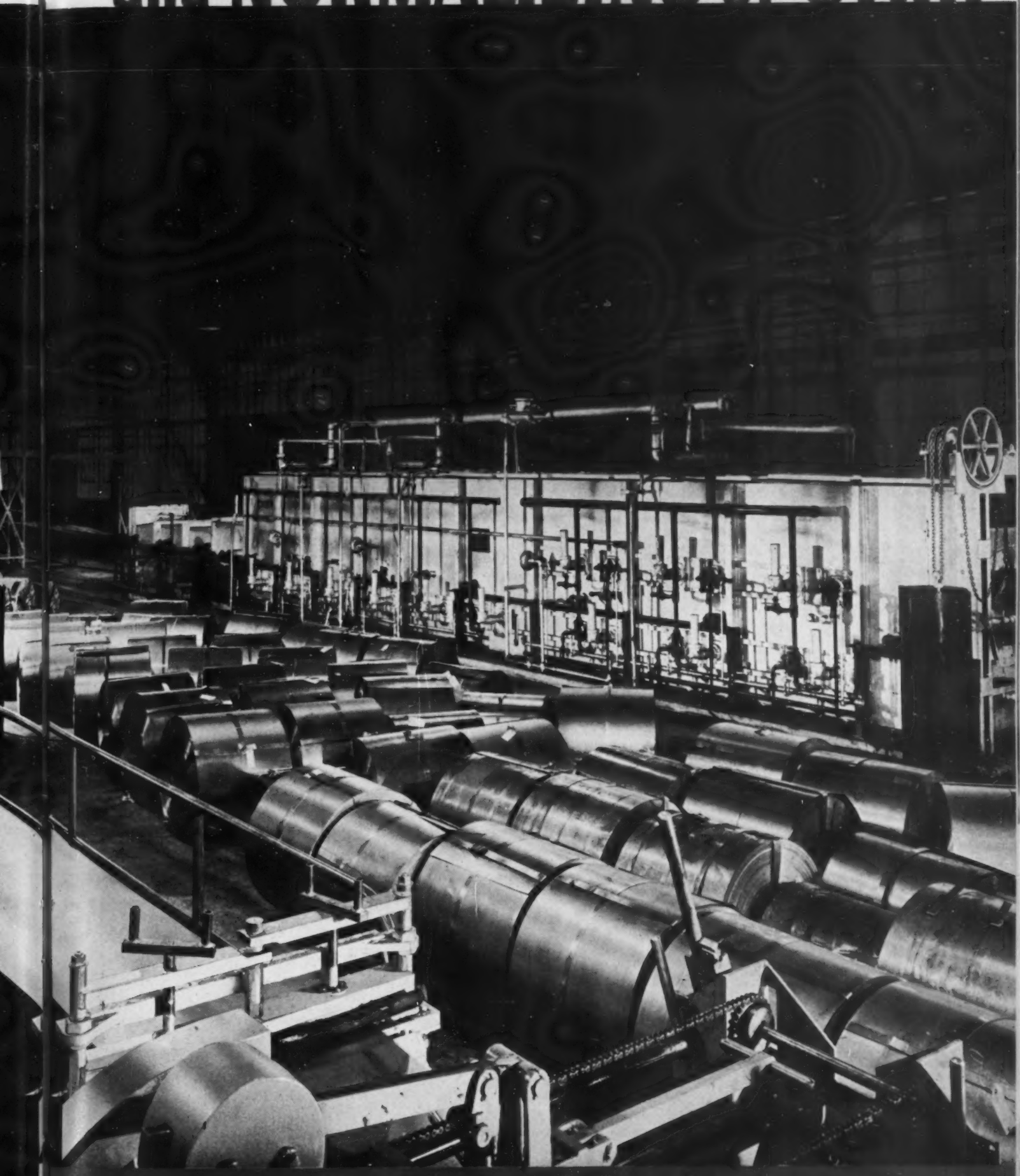
Wherever heat is used—from the ingot to finished product, it pays to consult "Surface "Engineers about modern methods and equipment.

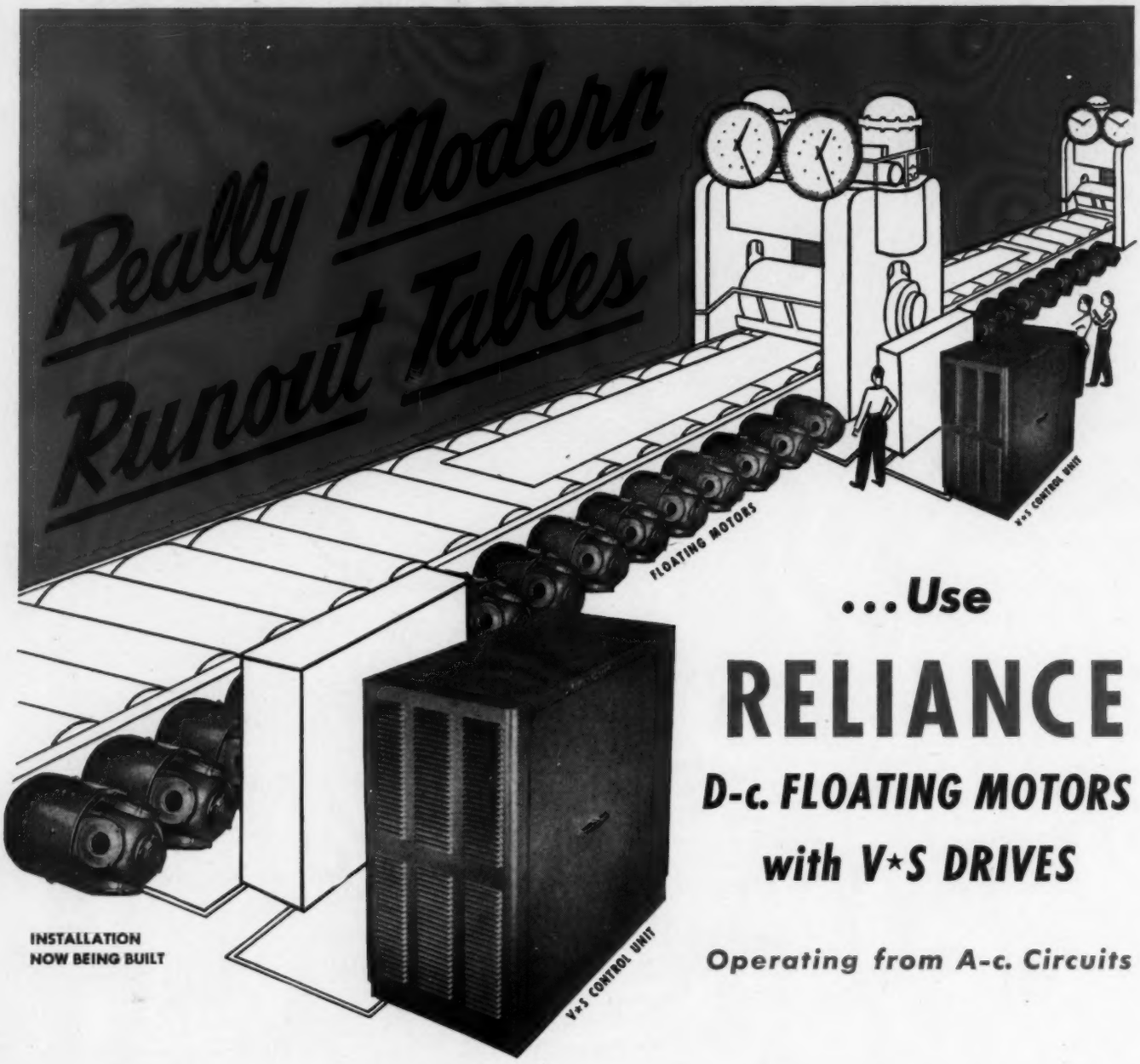


'Surface'

SURFACE COMBUSTION
TOLEDO 1, OHIO

and NORMALIZING of STRIP





...Use

RELIANCE

D-c. FLOATING MOTORS with V★S DRIVES

Operating from A-c. Circuits

Make way for something new and better in runout tables! Reliance D-c. Floating Motors will eliminate the need for couplings and mountings—save precious space—keep material moving even if rollers warp or the table becomes uneven. Misalignment of motors and rolls will be impossible. And through on-the-spot conversion of A-c. power, conveniently-packaged Reliance V★S Drives will provide the D-c. power for stepless speed changes, quick starting, stopping and reversing. No separate motor room will be necessary—installation costs will be less. For further details, phone your nearest Reliance Representative (cities listed below) or write direct to our factory.

RELIANCE ELECTRIC & ENGINEERING CO.

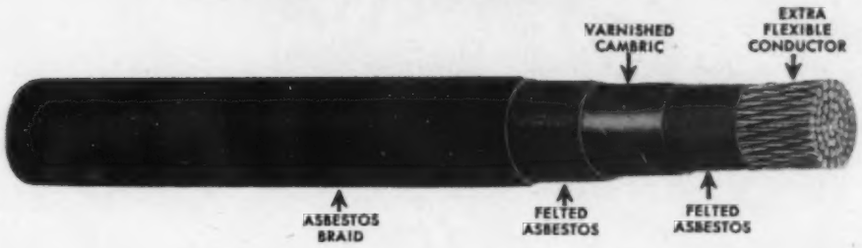
1084 Ivanhoe Road **Cleveland 10, Ohio**

Appleton, Wis. • Birmingham • Boston • Buffalo • Chicago • Cincinnati • Denver • Detroit • Gary • Grand Rapids • Greenville
Houston • Kansas City • Knoxville • Los Angeles • Milwaukee • Minneapolis • New Orleans • New York • Pittsburgh
Portland, Ore. • Rockford • St. Louis • San Francisco • Seattle • Syracuse • Tampa • Tulsa • Washington, D. C.
Sao Paulo, Brazil

RELIANCE A-C D-C MOTORS *"Motor-Drive is More Than Power"*

OKOBESTOS CABLE

(the cable with the asbestos suit)



THE STUFF IT'S MADE OF...

First, **FELTED ASBESTOS,** impregnated with heat and moisture-resisting compound, is applied directly over the copper conductor.

Then, **VARNISHED CAMBRIC,** in a succession of helical tape wrappings, provides a layer of high dielectric strength insulation.

Again, **FELTED ASBESTOS,** similar to the first layer, forms a flame, heat and fire resistant barrier to outside conditions.

Finally, **ASBESTOS BRAID,** woven from heavy asbestos fibre threads, impregnated with a black moisture-resisting compound, secures the entire assembly in a durable, protective covering.

...RESISTS HEAT AND CORROSION

HEAT AND FLAME RESISTANCE—There's no need to explain the non-combustible nature of asbestos. Stable and permanent, asbestos has been used by the U. S. Navy for years to protect shipboard cables from the external fires of battle damage. Cables installed near furnaces, boilers, soaking pits and other hot locations need Okobestos protection.

CORROSION RESISTANCE—Wherever corrosive fumes, chemicals, oil, solvents are found, those are places for Okobestos cables, whose inert, durable asbestos coverings stand up indefinitely under these conditions.

MECHANICAL STRENGTH—Okobestos cables retain their strong, mechanical ruggedness. They have no organic outer coverings to rot or mildew.

The cable shown above is an extra-flexible strand Type AVA apparatus cable which can be operated up to 110°C (230°F) and is only one of many designs of Okobestos cables available for specific needs. Bulletin OK-2061 describes the types, ranges and applications. The Okonite Company, Passaic, New Jersey.

OKONITE SINCE 1878 **insulated wires and cables**

4918

back of the metal-cutting abrasives . . .

INTERNATIONAL GRAPHITE ELECTRODES

WHEREVER you see hard, metal-cutting abrasives in action, you can be reasonably certain that International Graphite Electrodes had a part in their manufacture. For leading makers of abrasives—like producers of fine alloyed metals—have learned through long experience that fine quality control of product in electric furnaces calls for perfection in every production detail. Likewise these producers have proved to their own satisfaction in the severest tests of all—in actual furnace operation under a wide range of production requirements – that International Graphite Electrodes offer the physical, electrical, and chemical properties in the right combination for their exacting needs.

Check over the qualities *you* want in electric furnace electrodes—the properties you'd give them if you were *making* electrodes as well as *using* them. You'll find, too, that International Electrodes fully measure up to every exacting standard by which electrodes are judged.

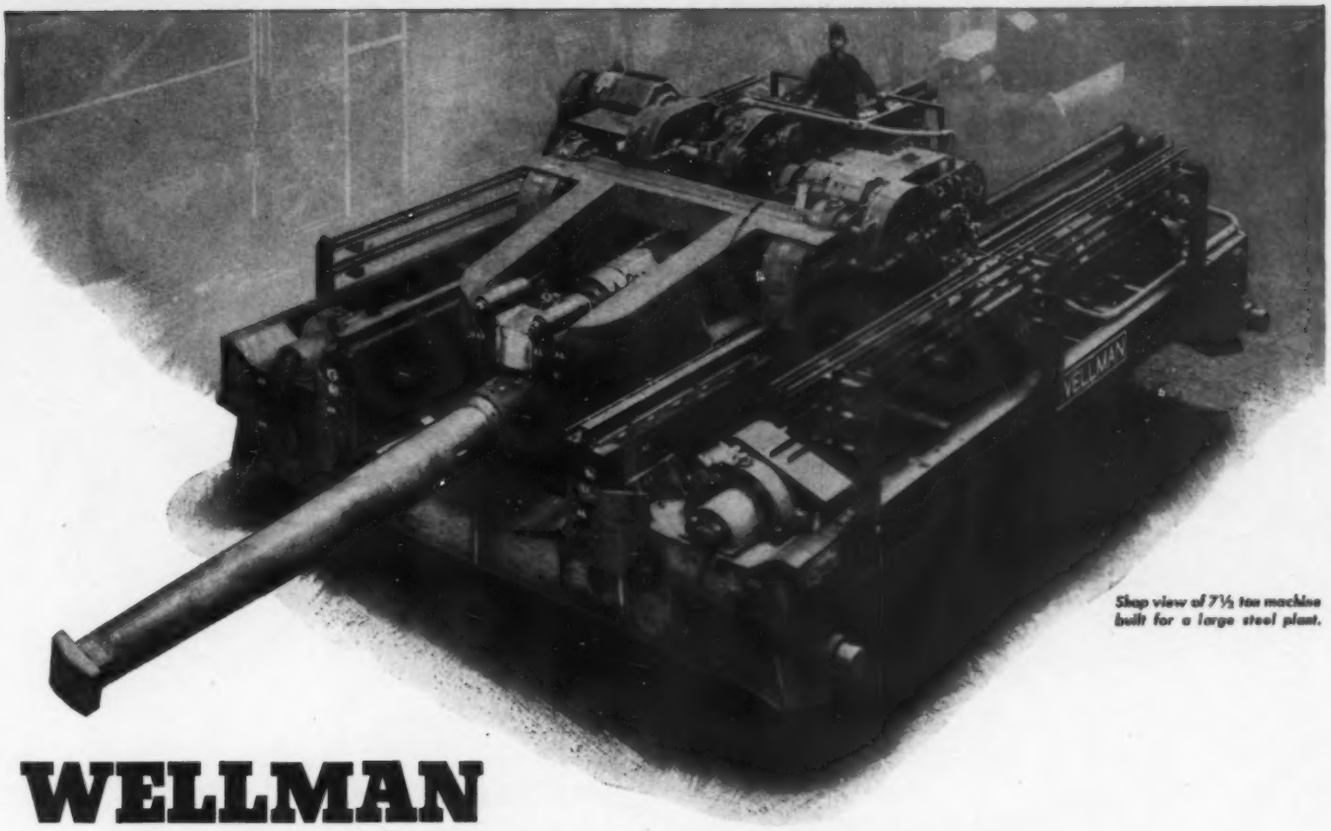
For all-around satisfaction and economical performance, specify International the next time you buy electrodes; find out first-hand why they are so widely preferred by electric furnace operators. Write for details and prices today.

Specify INTERNATIONAL Graphite Electrodes for—Slow consumption—High current capacity—Low rate of oxidation—High thermal conductivity—High degree of purity—Consistently uniform properties and dimensions—Low cost per ton of production.

International Graphite & Electrode Corp.
SAINT MARYS, PA.

2284

ICE



Shop view of 7½ ton machine built for a large steel plant.

WELLMAN

MANUFACTURES THE MOST COMPLETE LINE OF

CHARGING MACHINES

10 ton Low Type Wellman Charging Machine.

5 ton High Type Wellman Charging Machine.

Wellman originated the labor saving, mechanical charging of open hearth furnaces and now makes most complete line of improved, modern chargers. Some features: one-piece furnace annealed cast steel trolley frame . . . air tight gear cases . . . modern roller bearing design (optional) . . . bridge framework with main and auxiliary girders. Wellman makes Low Type (5, 7½, 10 and 12 ton) High Type (5 ton) Crane and Revolving Types, also charging machines for heating furnaces, and manipulators for forging presses and hammers.

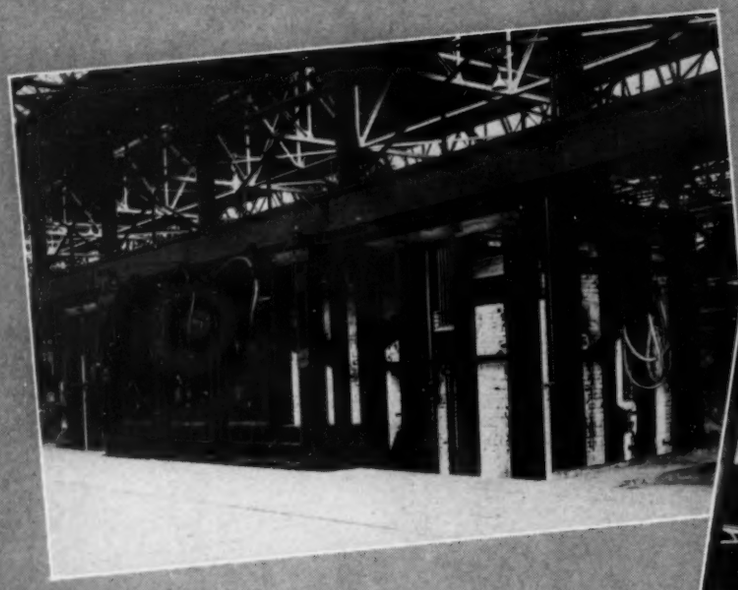
WELLMAN WILL BUILD IT!

Car Dumpers • Coke Pushers
Clamshell Ore Buckets
Ore Bridges • Mine Hoists
Gas Producers • Soaking Pits
Skip Hoists • Wharf Cranes

THE WELLMAN ENGINEERING COMPANY

7031 Central Avenue Cleveland 4, Ohio

Demand these Features in Your Open Hearth FURNACE



Water cooled Doors and Frames — Automatic Fuel Reversal control — Heavy Structural Framing

Water Cooled Reversing Valves and Dampers — Electric Door Hoists — Combustion Air Fan

Open Hearths, Stationary and Tilting, all capacities—Acid or Basic—Gas, Oil or Combination Firing Furnaces

Sound Design • Rugged Construction
Accurate Control • Superior Performance

610 SMITHFIELD ST. **LOFTUS ENGINEERING** *corporation* PITTSBURGH, PA.

Designers and Builders — Engineers, Consultants, Contractors

This 84 inch BAILEY THERMAL VALVE

Installed—April 1, 1930, removed from gas main for repairs July 31, 1946. Average operation—30 times per month.

NEVER FAILED TO OPERATE in 16 years of service!

This Valve never failed to operate every time a tuyere was changed and at every shut-down.

Tonnage produced on furnace in 16-year period—5,800,000 Tons.

FOR THE SAFETY OF YOUR WORKMEN USE BAILEY GOGGLE VALVES

It pays to install them and take care of them!

LEADERSHIP THROUGH QUALITY

WILLIAM M. BAILEY COMPANY *Engineers* PITTSBURGH 22, PA.

WHEN those white hot slabs roll out on your tables, the bearings underneath get sizzling hot. In fact, it's not uncommon for some table-roll bearing temperatures to rise to 400°, and even higher.

Under such terrific heat, the grease guarding these bearings has a tendency to soften and run out. Also, in the colder table-roll bearings there's always water present to add its washing action.

It takes a tough bodyguard to match these tough conditions, a specially designed lubricant like Gargoyle Grease Sovarex L. Proved in many mills, this special grease resists softening at high temperatures and sticks on despite the washing action of water.

★ ★ ★

On work-rolls, back-up rolls and many other spots throughout your mill, this superior Socony-Vacuum product maintains its strong films under heavier pressures than any other grease. Put it on guard in your mill now for longer bearing life, lower maintenance costs and more continuous production.

GARGOYLE Lubricants

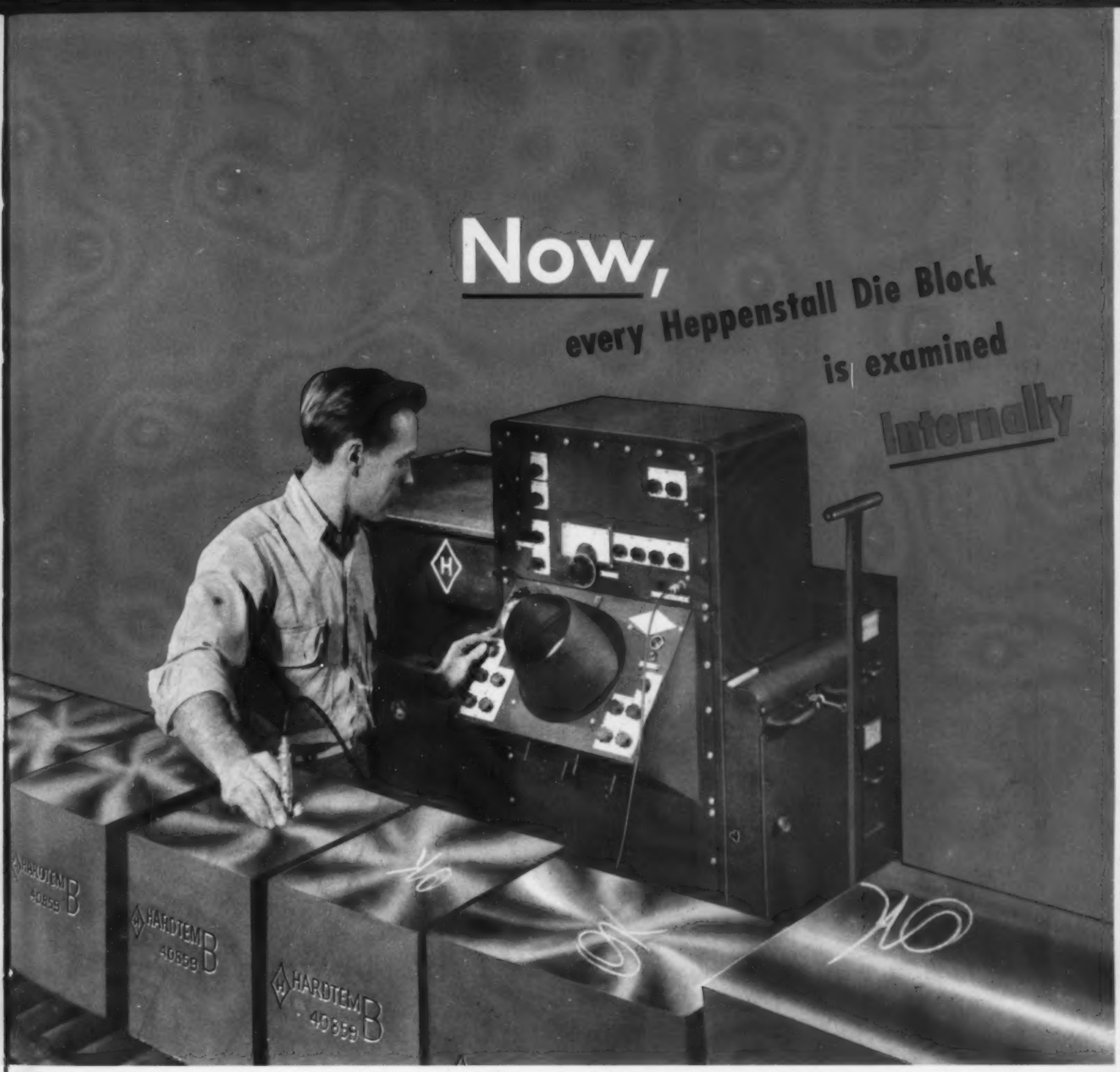
SOCONY-VACUUM

SOCONY-VACUUM OIL CO., INC.
and Affiliates: Magnolia Petroleum Co.
General Petroleum Corporation

TUNE IN THE MOBILGAS PROGRAM — MONDAY EVENINGS, 9:30 E.S.T. — NBC

Socony-Vacuum Correct Lubrication

FOR EVERY MACHINE . . . EVERY OPERATING CONDITION



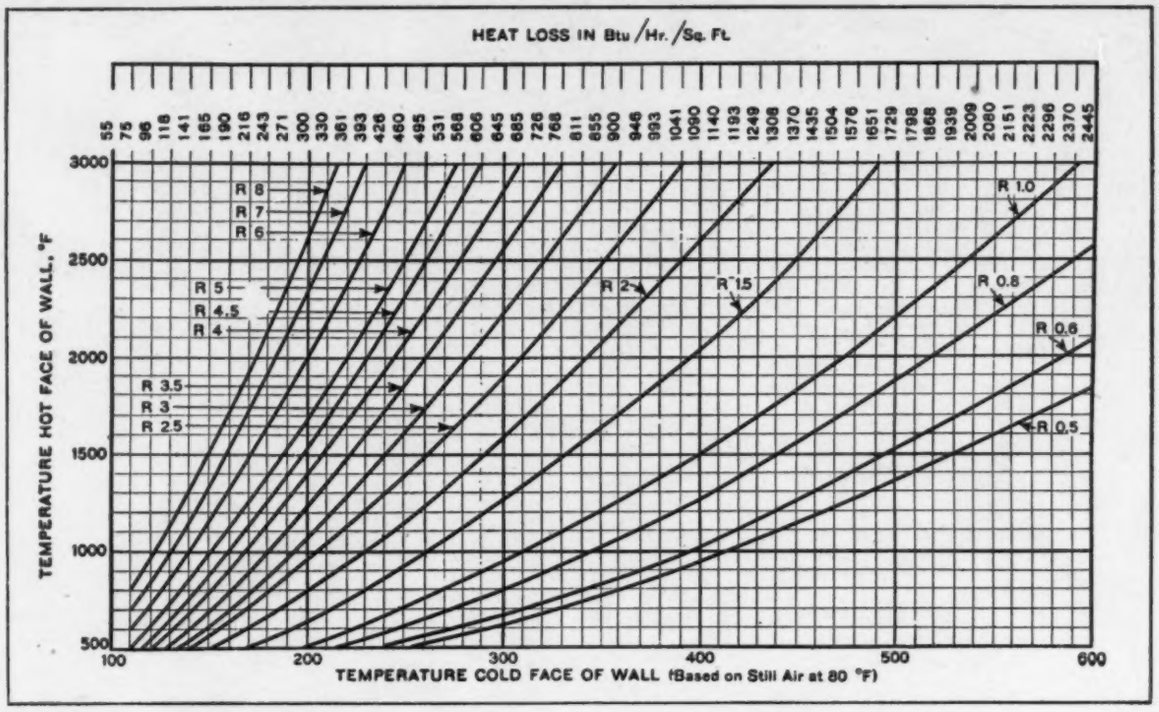
SPECIAL ANALYSIS STEEL, and the very highest degree of forging and heat treating skill, are vitally important in making Heppenstall Hardtem Die Blocks. But many metallurgical reactions occur during steel making, forging and heat treating. Until recently, there was no satisfactory way to examine the internal structure of the finished die blocks to determine whether best of metals and unexcelled techniques had combined to produce blocks free of faults. We regularly sawed blocks apart and examined them, but that didn't prove that following and preceding ones were uniformly good.

Now, we can answer our own question of what has happened within a block during its making! For the past year we have been testing a supersonic device which permits looking inside every die block produced in our plants. Sound waves, passed through the block, detect any thermal crack, discontinuity, or foreign material in their path. Exact location of a fault and its magnitude, are clearly shown. Any block which does not meet rigid Heppenstall standards is rejected. Thus, we guarantee you die blocks free of performance-affecting faults—faults which, formerly, neither we nor you could detect until you sunk the die or placed it in service.

So, final quality of Heppenstall Die Blocks—the only quality in which you are interested—is assured by still another Heppenstall advancement. That quality makes them the most economical die blocks you can buy—from every standpoint—more forgings per sinking, more sinkings per block, fewer block failures!

HEPPENSTALL COMPANY
Pittsburgh 1, Pa.

HEPPENSTALL *The most dependable name in forgings.*



For a one component wall $R=\frac{L}{K}$ where L = thickness of wall in inches

K = Conductivity (Btu/sq. ft./degree F difference in temperature/in. thick)

For a wall of n components $R=\frac{L1}{K1}+\frac{L2}{K2}+\cdots\cdots+\frac{Ln}{Kn}$

where L_1, L_2, etc. = thickness of each component

K_1, K_2, etc. = conductivity of each component

Temperature at First Joint from Hot Face = Hot Face Temperature — (Btu loss x $\frac{L1}{K1}$)

" " Second Joint from Hot Face = First Joint Temperature — (Btu loss x $\frac{L2}{K2}$)

For Efficient Industrial Furnaces Check Wall Design with This Chart

Engineers and builders of industrial furnaces can easily check heat-flow calculations with this chart. Heat loss and outside wall temperature can be read directly when inside temperature, wall thickness and conductivity of refractory are known. And the insulating effect of different wall sections can be quickly compared.

For adaptability to service requirements, Refractory Concrete—made with LUMNITE and a refractory aggregate—has unique advantages. Conductivity and refractory limit depend on the mix and the type of aggregate. For example, certain light-weight aggregates yield Refractory *Insulating* Concrete with conductivity one-third that of Refractory Concrete made with LUMNITE and crushed firebrick.

Refractory Concrete is cast in place to fit the job. The wall or arch can be just the right thickness for efficient operation of the furnace. A 6-inch or 15-inch wall can be built as easily as one which is 9 inches or 13½ inches thick.

A Booklet, "Heat Transmission Through Furnace Walls," contains ten similar time-saving charts. For your free copy, write: LUMNITE DIVISION, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York 17, N. Y.

LUMNITE FOR REFRACTORY CONCRETE

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel—Sunday Evenings—ABC Network*

NON-FLUID OIL

TRADE MARK REGISTERED

ARRESTS FRICTION

NON-FLUID OIL arrests friction because it provides positive lubrication upon split-second demand as soon as your machinery starts up. It does not have to be aided or softened by frictional heat before starting to lubricate — as is the case with ordinary greases. In fact, NON-FLUID OIL keeps bearings noticeably cooler.

Furthermore, it outlasts grease several times, its greater durability being especially marked when it is used in warm weather or on machinery in hot locations. Under such conditions grease melts and wastes freely, but NON-FLUID OIL retains its consistency, not being affected by temperature changes.

NON-FLUID OIL, the modern lubricant, is produced from the very highest grade petroleum. A special process enables it to overcome the drawbacks of oil and grease. It is produced in grades exactly adapted to the lubrication of every type of machine. NON-FLUID OIL is applied in the same way as liquid oils and greases and does not require the purchase of any special lubricating appliances or any changes in lubricating technique.

WORKS: Newark, N. J.
WAREHOUSES. Charlotte, N. C. · Greenville, S. C.
Atlanta, Ga. · Providence, R. I. : Detroit, Mich.
Chicago, Ill. · St. Louis, Mo.

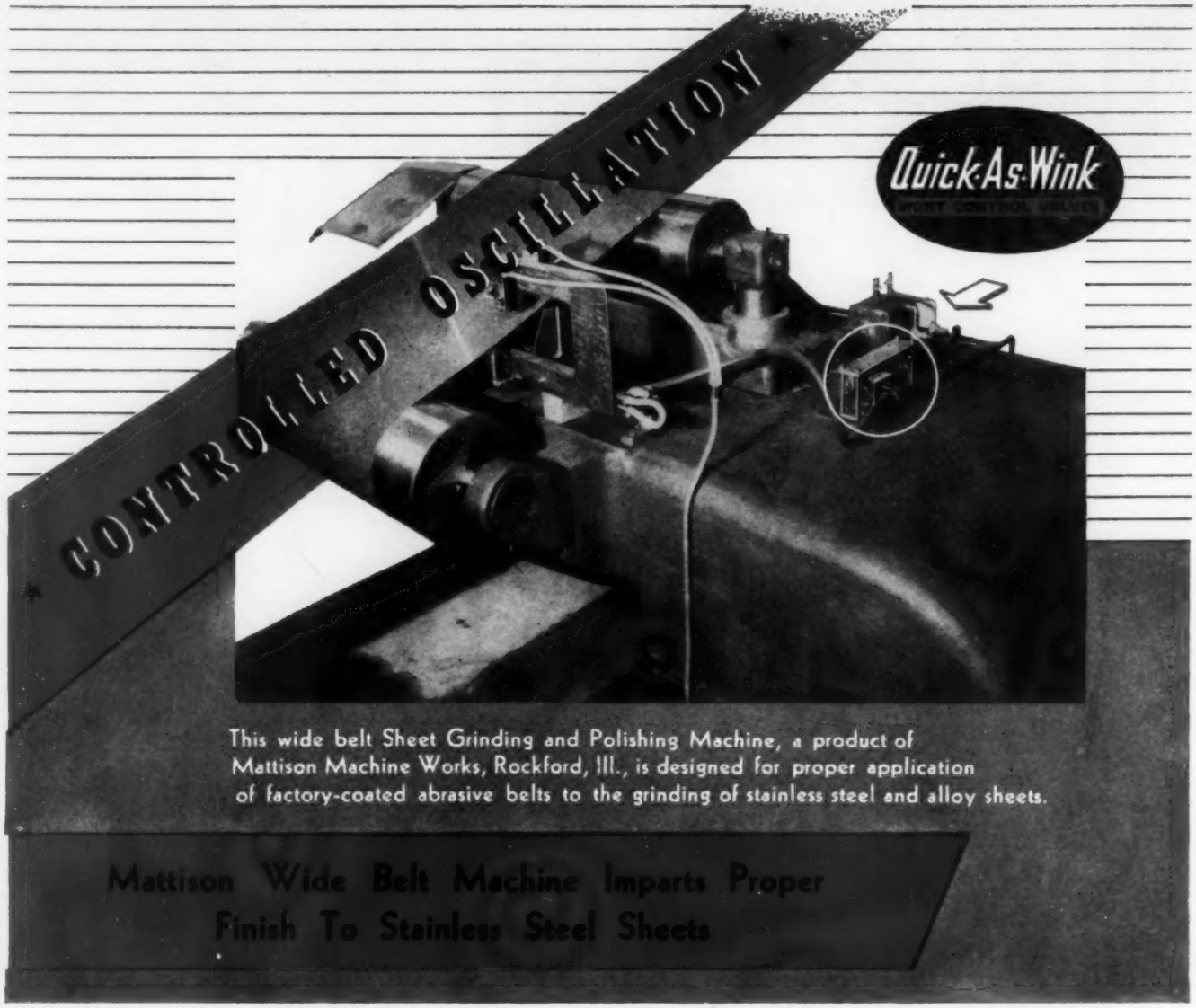
Current Quote

"Since using NON-FLUID OIL we have practically eliminated bearing failures which we had experienced in the past."

N. Y. & N. J. Lubricant Co., Dept. I.
292 Madison Avenue, New York 17, N. Y.
Please send testing sample of NON-FLUID OIL to be used in the following machinery:
.....
.....
Name.....
Company.....
Street.....
City.....State.....

NEW YORK & NEW JERSEY LUBRICANT CO.

292 MADISON AVENUE, NEW YORK 17, N.Y.



This wide belt Sheet Grinding and Polishing Machine, a product of Mattison Machine Works, Rockford, Ill., is designed for proper application of factory-coated abrasive belts to the grinding of stainless steel and alloy sheets.

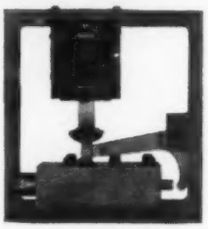
Mattison Wide Belt Machine Imparts Proper Finish To Stainless Steel Sheets

Two Quick-As-Wink solenoid valves are used on this wide belt sheet grinding and polishing machine, a product of Mattison Machine Works, Rockford, Illinois. A 4-way double solenoid-controlled Quick-As-Wink valve controls the belt oscillation by operating an air cylinder which swivels the top idler roll. Photo cells, which actuate the air valve, control travel of the oscillation.

A 2-way solenoid-operated automatic Quick-As-Wink return valve works in conjunction with the controlled air pressure. By means of this second Quick-As-Wink valve, the air pressure is released momentarily at the table reversal, reducing the grinding pressure of the sheet.

Quick-As-Wink valves are available in solenoid, hand, foot, and diaphragm operated for air, also hand and pilot operated hydraulic types for water or oil applications.

New Quick-As-Wink bulletin available upon request.



¼" Single Solenoid, Spring Return, 4-way single plunger Quick - As - Wink valve. The valve used on this machine is a double solenoid.

The Single Plunger line of Quick-As-Wink valves has extruded brass or cast bronze housings, depending on the size, ground and polished stainless steel plungers. Solenoid valves are mounted in heavy welded steel frames. All sizes for diversified requirements.

THE HIGHER THE PRESSURE AIR WATER OIL THE TIGHTER THE SEAL

C-B-HUNT & SON, INC. SALEM, OHIO

You should consider CLARK CONTROL in your 1947 Plans—*Here's why:*

Backing The Clark Controller Company plant are District Engineering Offices and Agencies in

AKRON	DETROIT	PHILADELPHIA
BIRMINGHAM	GARY	PITTSBURGH
BOSTON	HOUSTON	PORTLAND
BUFFALO	HUNTINGTON	ST. LOUIS
CHARLOTTE	KANSAS CITY	SALT LAKE CITY
CHICAGO	LOS ANGELES	SAN FRANCISCO
CINCINNATI	MINNEAPOLIS	TAMPA
CLEVELAND	NEW YORK	TULSA
DENVER	OMAHA	YOUNGSTOWN

Each of these, located in America's industrial centers, is manned by trained and experienced Electrical Control Application Engineers—thus bringing mature knowledge to your door.

Scattered all over the country, also in industrial areas, are 145 Distributors with stocks of "3C" Electrical Control apparatus, thus providing prompt service on your auxiliary control needs.

In the main plant you'll find trained Electrical Control Engineers, constantly in touch with—and solving—diversified electrical control problems. This wide knowledge is entirely at your service.

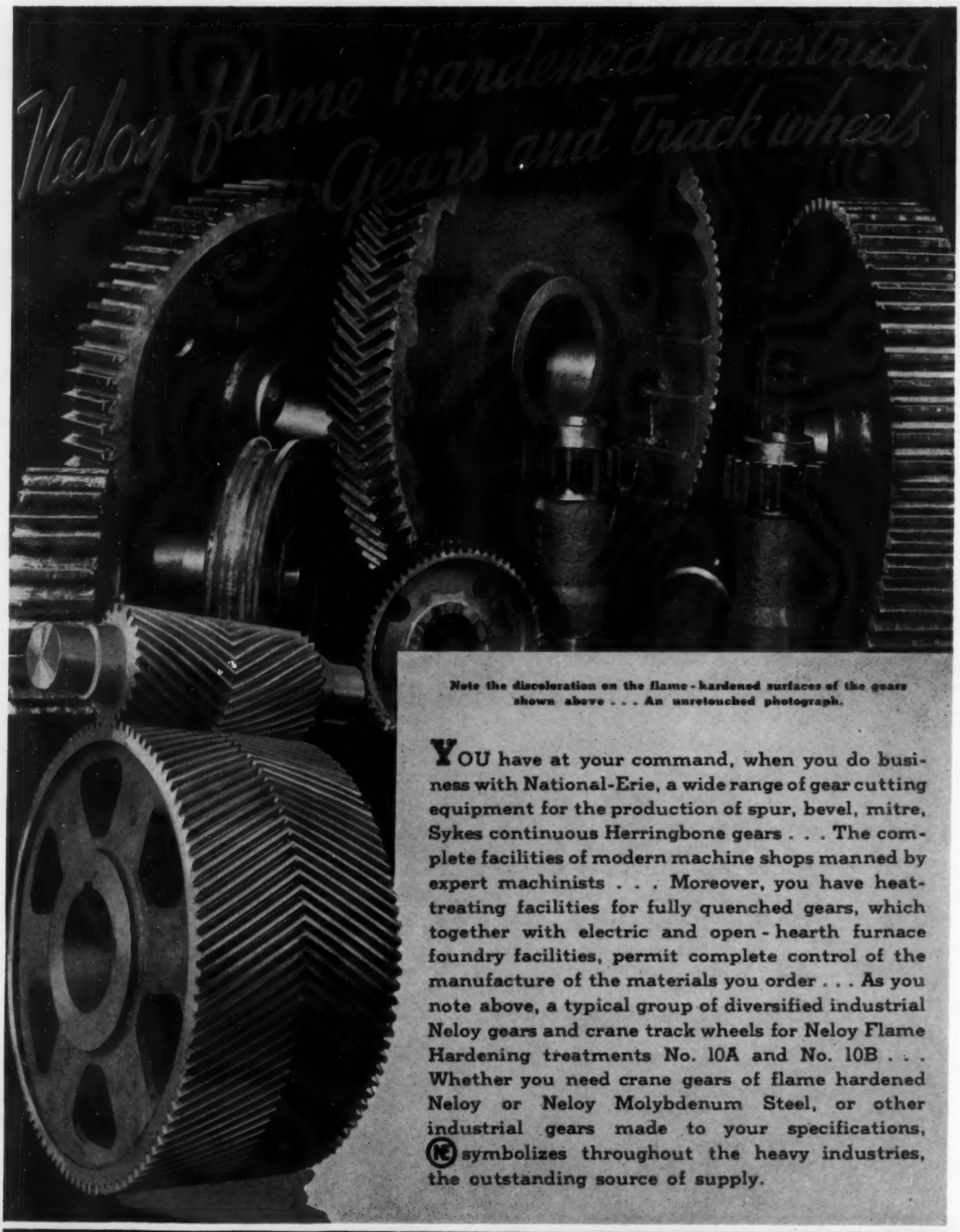
In the plant are modern machinery, modern methods. Employees are trained and are familiar with all details of production to provide properly designed and *sturdy-built* apparatus—proven in heavy-duty operation—for "on-time" deliveries.

You'll find it advantageous from all angles to give every consideration to "3C" apparatus when planning your 1947 electrical control needs.

Our District Offices and Agencies are as near as your 'phone

THE CLARK CONTROLLER CO.

EVERYTHING UNDER CONTROL • 1146 EAST 152nd STREET, CLEVELAND 10, OHIO



Note the discoloration on the flame-hardened surfaces of the gears shown above . . . An unretouched photograph.

YOU have at your command, when you do business with National-Erie, a wide range of gear cutting equipment for the production of spur, bevel, mitre, Sykes continuous Herringbone gears . . . The complete facilities of modern machine shops manned by expert machinists . . . Moreover, you have heat-treating facilities for fully quenched gears, which together with electric and open-hearth furnace foundry facilities, permit complete control of the manufacture of the materials you order . . . As you note above, a typical group of diversified industrial Neloy gears and crane track wheels for Neloy Flame Hardening treatments No. 10A and No. 10B . . . Whether you need crane gears of flame hardened Neloy or Neloy Molybdenum Steel, or other industrial gears made to your specifications, (NE) symbolizes throughout the heavy industries, the outstanding source of supply.

NATIONAL-ERIE
• CORPORATION •
ERIE, (NE) PA., U.S.A.

DEPENDABLE POWER

EXIDE-IRONCLAD POWERED ELECTRIC TRUCKS

CUT MATERIAL HANDLING COSTS

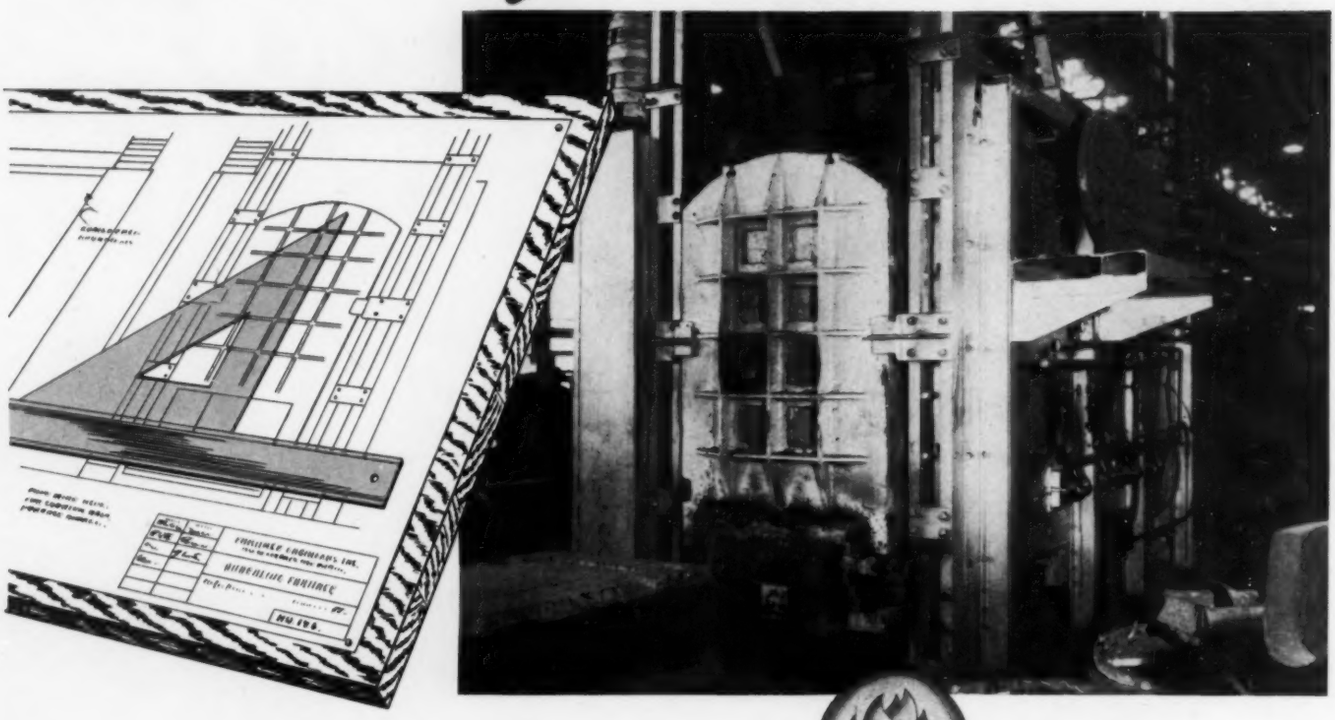
More and more industries are adopting the modern method of materials handling. They are giving the job to the efficient, time-and-cost saving electric industrial truck, which keeps goods moving fast at a steadier rate, with greater safety and at considerably reduced costs.

There are battery-electric trucks for every lifting, hauling and handling task. And for each there is a powerful Exide-Ironclad to assure peak performance with full shift availability. Because of their dependability, long-life and ease of maintenance, Exide-Ironclads are used in a majority of all electric industrial trucks.

Write for a FREE copy of Exide-Ironclad Topics which contains "Case Studies" of materials handling problems. Tells how to cut handling costs up to 50%... covers latest developments in handling materials from receiving to shipping.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32 • Exide Batteries of Canada, Limited, Toronto

FROM ORIGINAL PLANNING *to successful Operation*



F. E. I. EQUIPMENT

Direct-Fired Cover Furnaces for annealing, spheroidizing, Normalizing and Bright annealing of wire, rods, coiled strip, flat sheets and tin plate.
For Heavy Coil Loads: Patented Convection Base, gives 2 to 4 times longer service.
For Wire, Bar and Tube Mills: Galvanizing, Patenting and Normalizing Furnaces.
For Pipe, Sheet, and Job Plants: Hot Dip Galvanizing Furnaces.

Car Type Furnaces, Rod Heating, Lead Quenching, Ladle Heating and Salt Bath Descaling Furnaces.
Continuous Quenching and Tempering Furnaces—Quench Tanks, Water or Oil.

F.E.I.

★ From drawing board to production heating—that's the story of F.E.I. service. This skilled engineering results in the best furnace equipment to meet your particular requirements.

By taking the problem from the beginning F.E.I. installations, new equipment or conversion equipment, have proved their value in increased production and lower maintenance costs. No better proof of this is necessary than F.E.I. Performance Records. Complete information on request.

FURNACE ENGINEERS, *Inc.*

Specializing in the design, manufacture and installation of furnaces for the metal working industries

1551 WEST LIBERTY AVENUE ★ PITTSBURGH, PA.

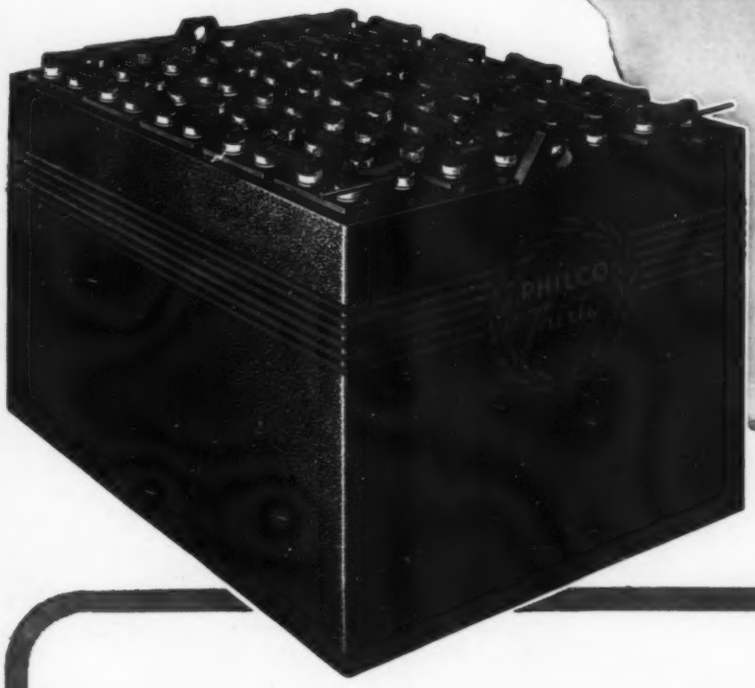
BATTERY-POWERED TRUCKS ARE SAFE!

"Battery-Powered Trucks can be used safely in practically all industrial occupancies...They have an excellent fire record...The Factory Mutual Laboratories have not found it necessary to make a special investigation of battery-operated trucks because of the slight fire hazard involved in their use. Standard trucks purchased from leading manufacturers can be expected to be reasonably fire safe. For extra-hazardous locations special trucks ...are available"

ASSOCIATED FACTORY MUTUAL FIRE INSURANCE COMPANIES

*Bulletin No. 11.24 on the Fire Hazards of Industrial Trucks and Tractors, July, 1946.

Quoted by permission.



*Copies of this bulletin dealing with battery-powered trucks and other types will be sent on request.

★*Modern construction, pioneered by Philco, gives 10% or more additional capacity in same battery space.*

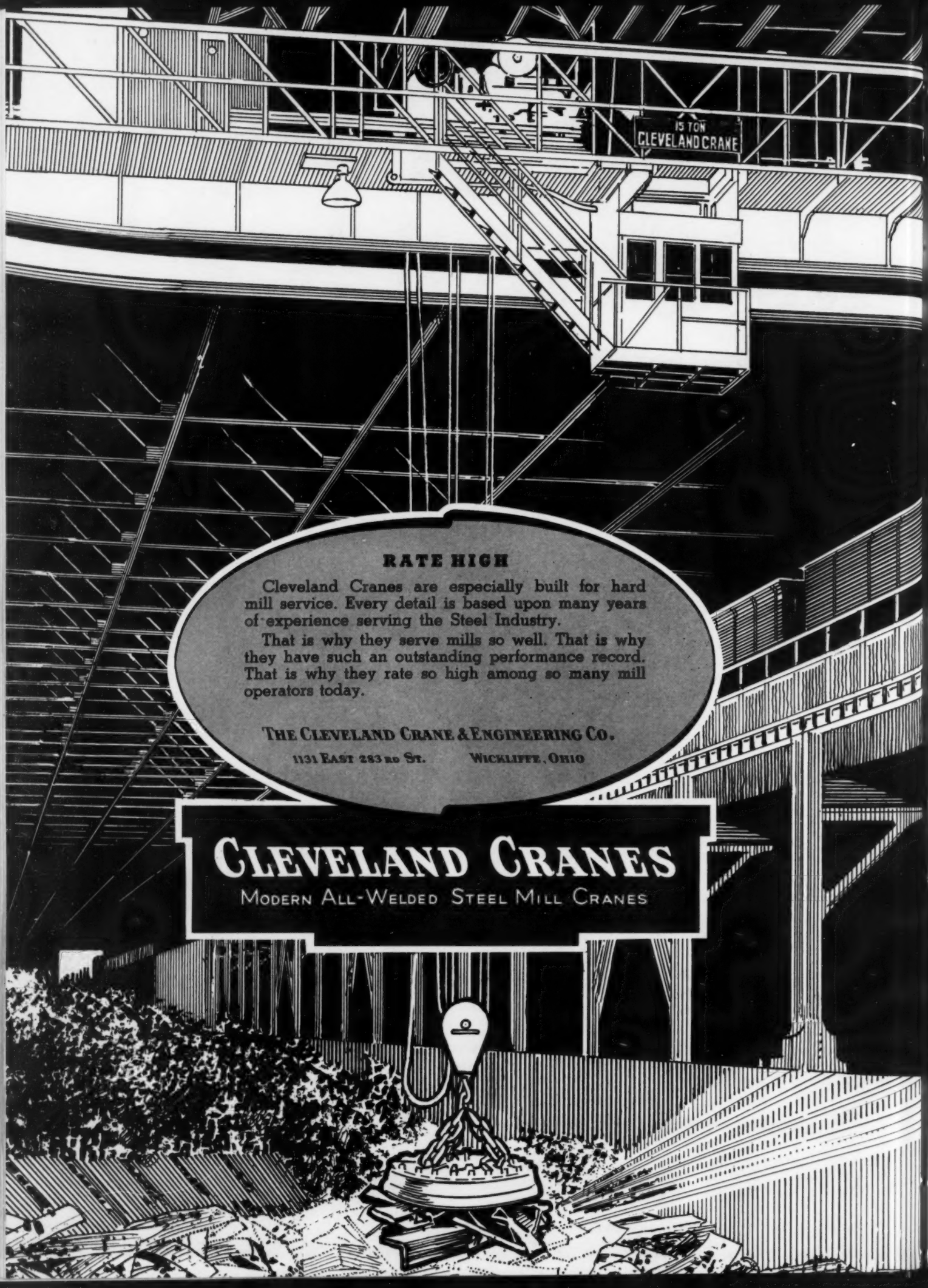
FOR 50 YEARS A LEADER IN STORAGE BATTERY DEVELOPMENT

The time-proved safety of battery-powered industrial trucks in materials handling work is, in reality, a plus! *Battery power costs less, too* . . . less by an astonishing margin where full capacity equipment is provided and utilized. In many such high-demand operations, the 10%★ extra capacity and 30% longer life of Philco "Thirty" Storage Batteries have introduced a new era in low-cost handling. Write today for latest catalog of specification data.

PHILCO CORPORATION • STORAGE BATTERY DIVISION • TRENTON 7, NEW JERSEY

PHILCO

Famous for Quality the World Over



RATE HIGH

Cleveland Cranes are especially built for hard mill service. Every detail is based upon many years of experience serving the Steel Industry.

That is why they serve mills so well. That is why they have such an outstanding performance record. That is why they rate so high among so many mill operators today.

THE CLEVELAND CRANE & ENGINEERING CO.

1131 EAST 283 RD ST. WICKLIFFE, OHIO

CLEVELAND CRANES

MODERN ALL-WELDED STEEL MILL CRANES

Crops *and* Shorts

IN general, 1946 left a rather dark brown taste in most of our mouths, caused principally by some 4000 strikes costing some 100-million man-days of productive effort. This unrest, coupled with fears of inflation, served to overshadow many happier statistics, including employment of over 60,000,000, production at boom level, record income, and savings several times the prewar rates. The new year may be less spectacular, but it should be more peaceful and satisfying. In spite of the calamity howlers, 1947 should be a good year.

▲

AMERICAN business is now spending about 54 per cent more for new factories and equipment than in the last peacetime year, 1941.

▲

PERHAPS much of the current unrest may stem from the facts brought out by the recent survey which showed that people's wants now number, on the average, 484, of which 94 are considered necessities. One hundred years ago, the average person had 52 wants, of which 16 were considered necessities.

▲

SOME weeks ago, one of the Sunday paper feature sections carried a story in which various alleged comedians moaned about a lack of appreciation of their particular brand of humor on the part of various audiences. Throughout their plaints, there was never a doubt implied that either the humor or the humorists were deficient — rather, the audience was held to be lacking in intelligence. At a risk of classifying ourselves among the morons, we must confess that much of the current humor leaves us cold. Perhaps job evaluation should be applied to the current crop of so-called comedians. Many of them would be startled at their own standing, but the knowledge, if it penetrated and were believed, might result in welcome improvements. And now, if any comedian cares to advise us on the intricacies of the steel industry, we'll be glad to listen.

▲

IN case you wondered about what you were eating during the meat shortage, you might reflect upon figures reported by the Department of Agriculture, showing that the total number of horses and mules on farms at the beginning of 1946 was 11,455,000, compared with 14,481,000 at the beginning of 1940.

IN a year-end statement, George R. Gibbons, vice president of Aluminum Company of America, gives 1946 production of new aluminum as 836,000,000 pounds, almost three times as much as was produced in 1938, but only about two-thirds of rated annual capacity. Production in 1947 may approximate 1,260,000,000 pounds. Basic aluminum prices, reduced by 25 per cent since the start of World War II, are now relatively lower than ever before, in the face of general price rises for competitive metals. In terms of volume produced, aluminum now ranks second among the metals of peacetime industry. At present, architectural and building applications have displaced transportation requirements as the leading consumption of aluminum.

▲

STEEL mill operations in 1946 averaged 71.6 per cent of capacity during the year, compared with 83.5 per cent in 1945. Operations during 1946 ranged from a low of 5.1 per cent in the week of January 21, during the steel strike, to a peak of 91.4 per cent in the week of November 18.

▲

SO far, suits entered against steel companies for retroactive portal-to-portal pay have averaged more than $1000 per worker. Extending this over the entire industry, we come up with perhaps three-quarters of a billion dollars — three or four years of respectable profits for the industry.

▲

A "portal-to-portal" suit in reverse has been instituted by the Rockwell Manufacturing Company, who entered suit for $15,000,000 against four labor union leaders to recover damages arising from slowdowns and admitted refusal to maintain production. It will be interesting to note the progress of this suit, which certainly has a more justifiable basis than almost all of the portal suits brought against companies by unions.

▲

THERE are approximately 468,000 stockholders in the steel industry, averaging about $10,000 of invested capital each. Each stockholder, on the average, thus is providing the facilities which enable approximately one and one-half workers to earn their living.

▲

IF liquor prices keep on rising, they will do a better job of drying up the country than all the prohibition activities together.

▲

REACHING a new high in the size of electric motors, four a-c units, each of 65,000 hp, will be used to drive pumps at Grand Coulee dam in Washington. The previous high was the 40,000 hp motor on a wind-tunnel fan at Wright field in Dayton, Ohio.

▲

ALL of us shudder when confronted by our battlefield casualties of 1,070,524 during World War II, but we remain callously calm about traffic accidents which totaled 3,394,000 killed or injured between Pearl Harbor and V-J day.

Pioneered by North American

LUMINOUS OR LONG FLAMES with either gas or oil are produced by the Series 113 Burners. They are desirable for vast coverage, for fewer burners and for uniformity of flame temperature.

SHORT FLAMES are produced by the Series 221 Burners. These burners provide a highly stable and efficient fire, using either gas or oil. They are recommended wherever heating in a relatively small space is required.

WRITE FOR DESCRIPTIVE LITERATURE

DUAL-FUEL BURNING SYSTEMS FOR GAS AND OIL

MAXIMUM EFFICIENCY WITH EITHER FUEL

SWITCH FUELS INSTANTLY

AUTOMATIC FUEL-AIR PROPORTIONING

WIDE TURNDOWN RANGE

THE NORTH AMERICAN MANUFACTURING COMPANY
MANUFACTURERS OF INDUSTRIAL FUEL BURNING EQUIPMENT FOR GAS OR OIL
BRANCH OFFICES with FIELD ENGINEERS in PRINCIPAL CITIES
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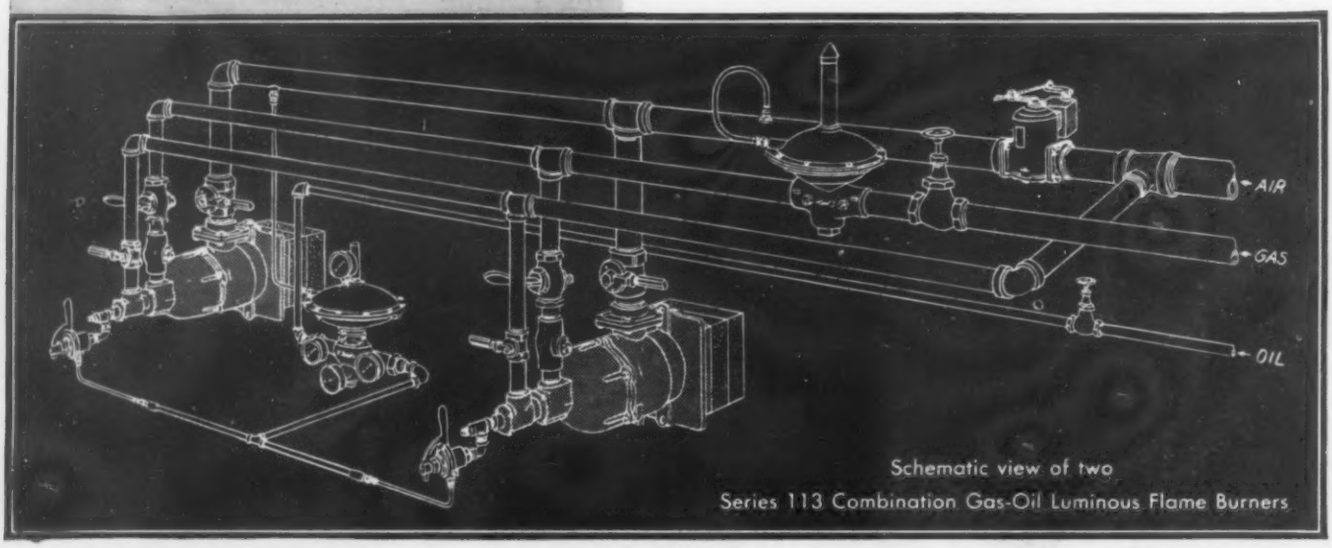

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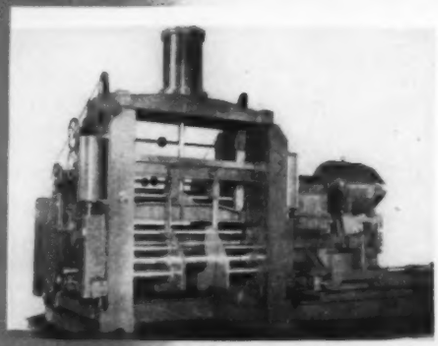
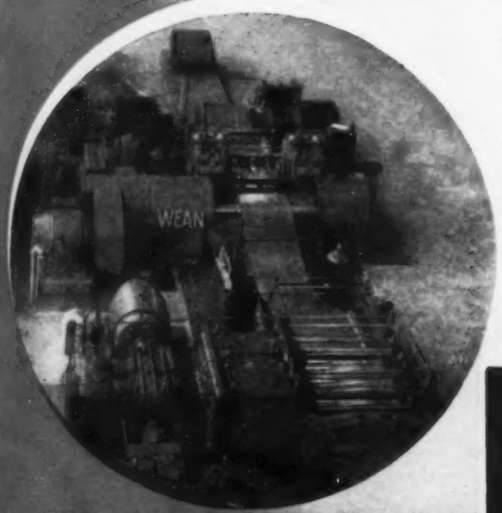


Backed Up Leveler for Wide Sheets



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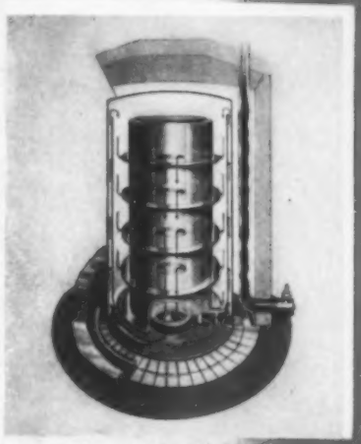

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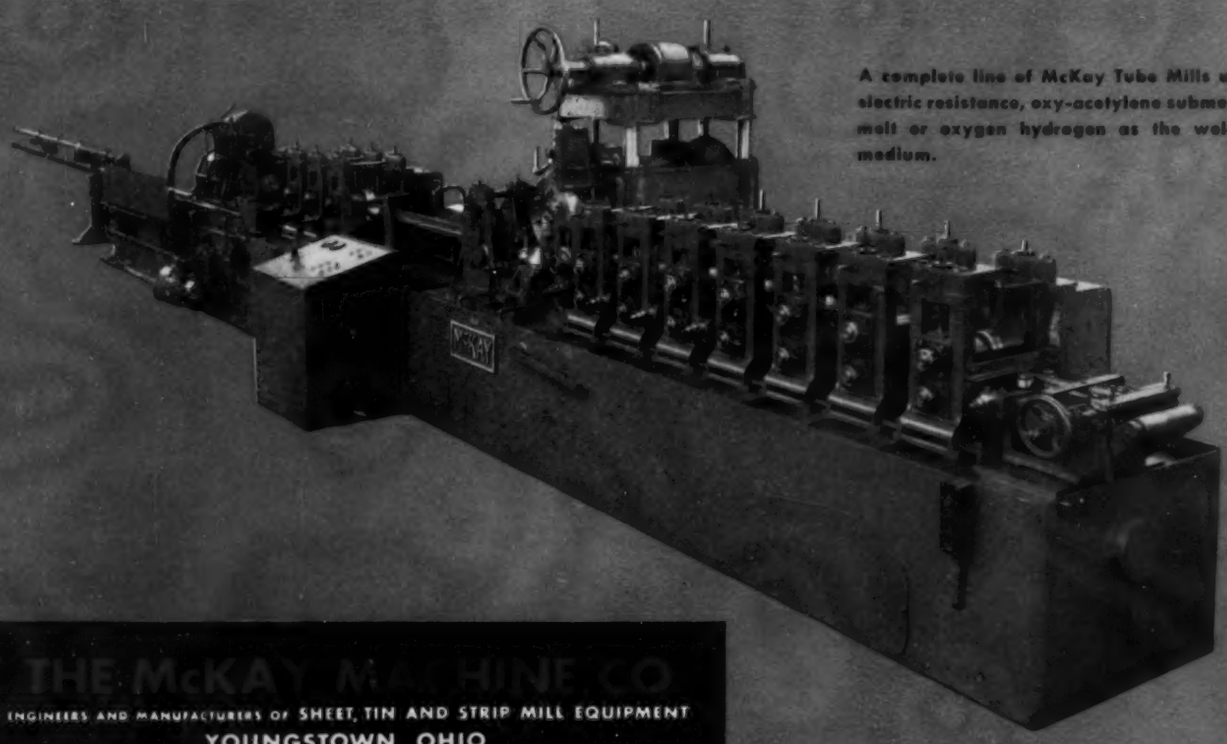

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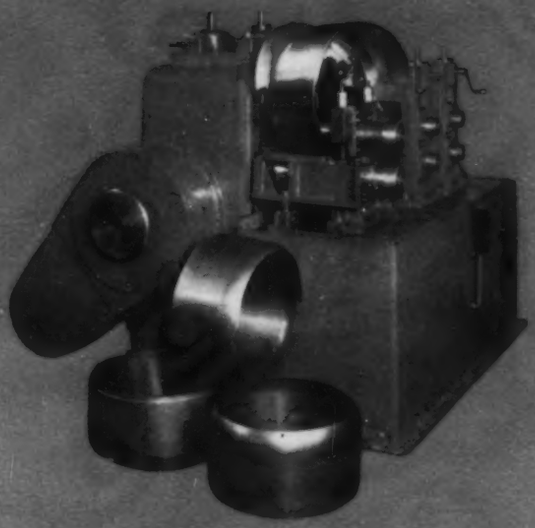

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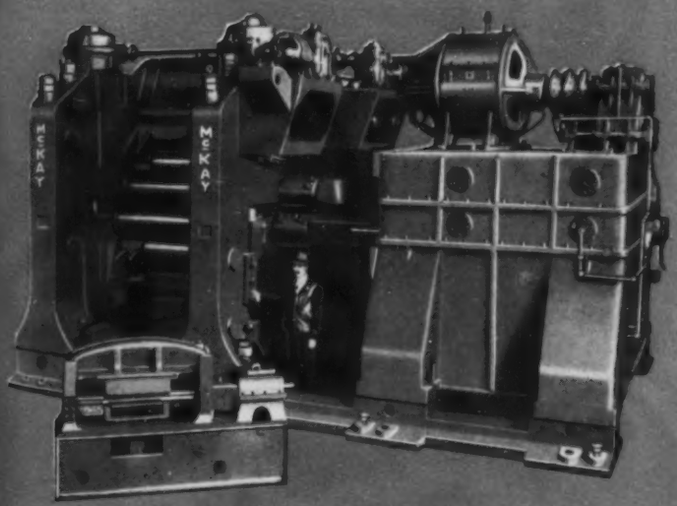

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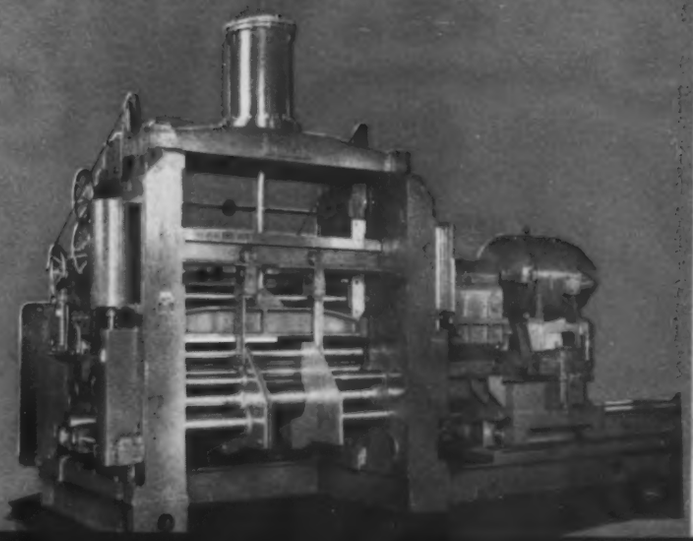

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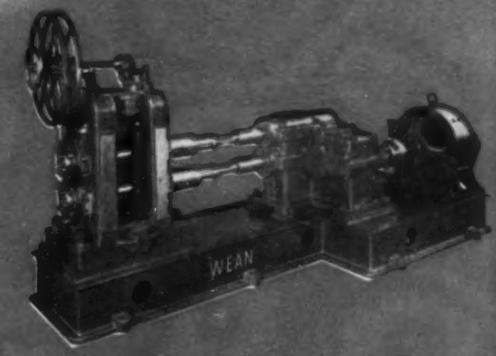
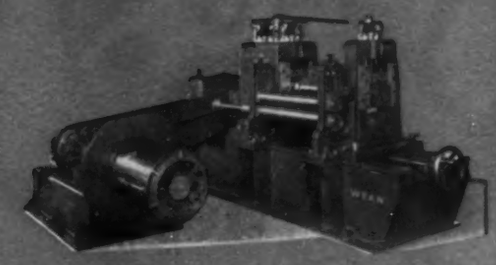


Small Cold Roll Strip Mill



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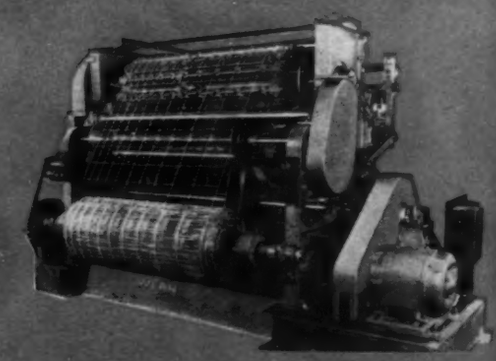
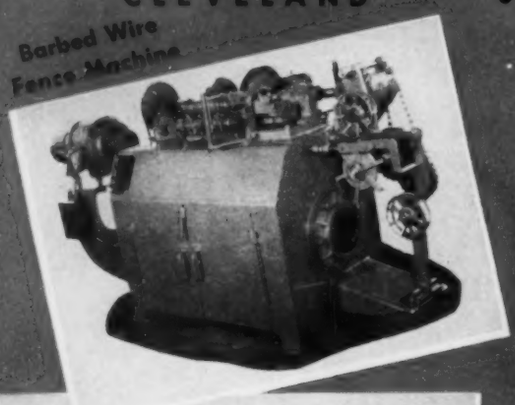


1155 Wire Fence Machine

Barbed Wire Fence Machine



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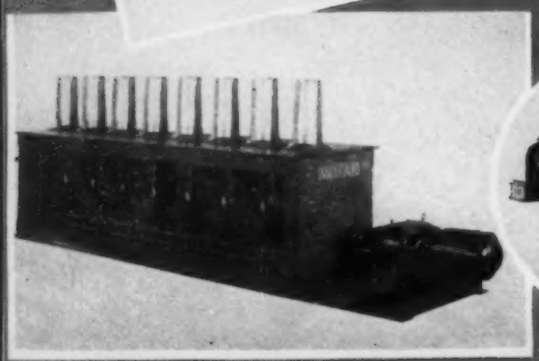

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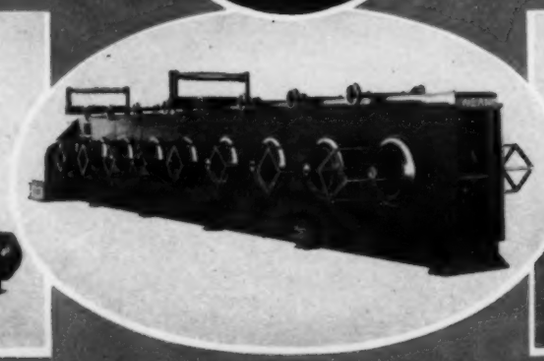

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Iron AND Steel ENGINEER

JANUARY, 1947 VOLUME XXIV NUMBER I

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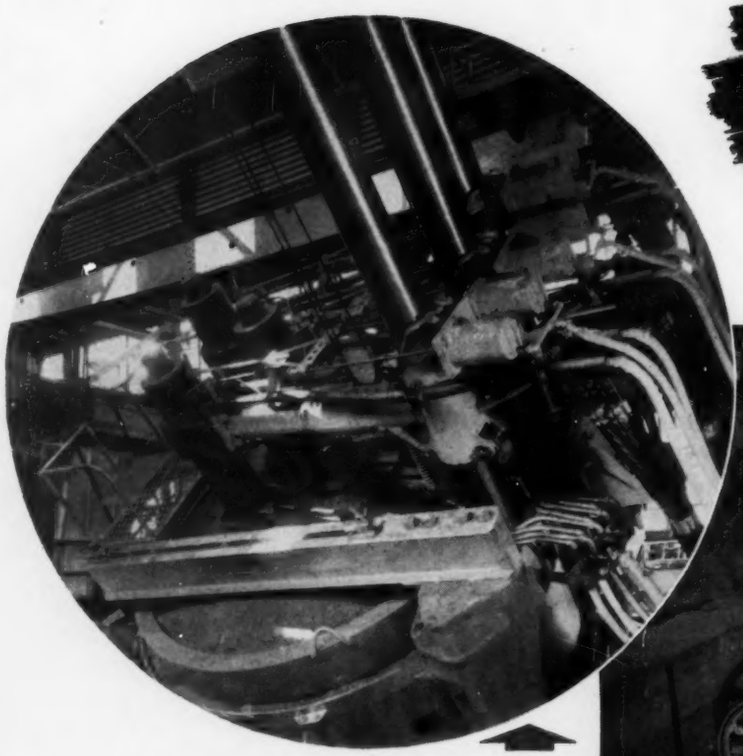

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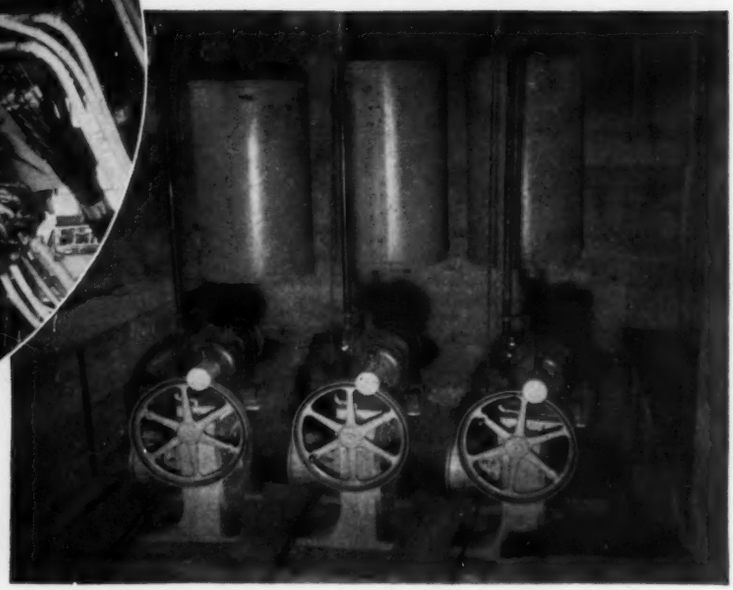

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The Art of Rolling Rounds

. . . . improved mill practice in rolling rounds may be obtained through improved groove design, rigid mills, bearings which wear slowly, and improved rolls and guide equipment . . . .

by Charles P. Hammond

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▲ FOR many years, the rolling of rounds has been a pertinent topic of discussion. This paper will be an attempt to outline the different methods of producing rounds, including details as to practice, equipment used, etc. There will be no intentional references made regarding the most desirable method, or practice, since individual mill conditions plus the human element play a most important part in the results obtained. A satisfactory method or practice on one mill or in one plant will not necessarily apply in another. Two mills in the same plant may be getting equal results with a different approach. However, apart from the differences in individual mill conditions, it is generally agreed that there is quite a difference between the rolling of mild steel and the highly alloyed grades, which is mainly in the method of reducing the billet rather than actually forming the round.

HAMMERED ROUNDS

Rounds were first made by hammering on flat dies and then later by using swage dies, shown in Figure 1.

Presented before AISE, Annual Spring Conference, Chicago, Illinois, May 6, 1946

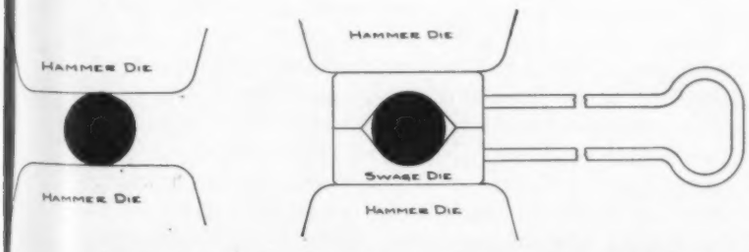


Figure 1 — In both the hammer forging and swaging of rounds, the bar is revolved between the die in final sizing and rounding of the bar.

The latter method was developed to increase production and to produce a round without flat planes, which were brought about through the use of flat dies. The swage die was made in two halves, joined together with a piece of flat spring steel, bent into a hairpin shape, and the two halves fastened to the ends of the hairpin. The dies were made so that the two halves completed the circle, each half with the proper opening on the sides to allow for spread after each blow of the hammer.

Rounds are still being made under a hammer, or press, especially large sizes of highly alloyed steels where the quantity involved does not warrant expensive, heavy rolling equipment.

ROLLING OF HAND ROUNDS

Making rounds by hand was the earlier method which, depending on size and length, required one or more tongsmen to guide and hold the bar in position during its passage through the rolls. This method is still being used today in many plants, especially in tool steel mills, since small orders and also the highly alloyed grades are more difficult to work in any other fashion, due to the rolls not biting consistently when rolling by guide.

Practically all of the tool steel plants, 30 years ago, were rolling rounds by hand, down to and including $\frac{3}{4}$ in. round and even some as low as $\frac{9}{16}$ in. round. One plant, 30 years ago, still had in their possession rolls to process $\frac{3}{8}$ in. rounds by hand. Some of these small sizes were made by hand because the customer demanded hand rounds. It took the manufacturers many years to educate the consumer and prove that a guide round was equal to, or possibly better than, a hand round. However, there is still doubt held by some of the consumers and also the people in industry, as to which method produces the better product.

Hand rounds have been produced by several different methods. Rolls may be turned with a number of grooves, each groove being used as a finishing pass when that

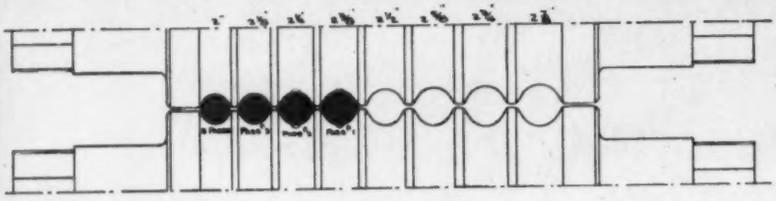


Figure 2 — In the two-high hand round roll shown, the number of lead grooves depends on the amount of opening, the amount of the draft from one groove to another, and the radius of the corners on the square entering the first lead groove.

size is required, shown in Figure 2. For example, a set of rolls ranging from 2 to $2\frac{3}{4}$ in. in increments of eighths of an inch would be a typical arrangement. To make a clean, well-filled round, it is neccessary to fill the groove ahead of the final finishing pass. For instance, in making a 2 in. round, enough stock must be started with to fill the $2\frac{1}{8}$ groove.

A regular, gothic groove can be used which reduces the number of lead passes. On mild steel, one lead pass is sufficient; however, on alloy steel, two or more passes are usually necessary. Using a regular 96 or 97 degree open square, and going twice through the square is the more common practice, see Figure 3. To secure a uniform square from a three-high set of rolls in which the steel has to be worked down in consecutive grooves, some rollers prefer to pass through the same final groove three times thus eliminating the close adjustments required to produce a uniform square from a 97 degree groove in two passes.

By taking a billet from a 96 or 97 degree square, after it has been passed through a groove, either two or three times, it is necessary to use at least 3 lead grooves besides the finishing groove. The number of lead grooves, of course, depends on whether the rolls are graduated in $\frac{1}{16}$ths or greater. Difficulty is encountered in endeavoring to reduce the number of passes, because the bar has to be guided by hand, while at the same time, the square has to be reduced gradually in order to distribute the stock uniformly. It is not an easy problem to maintain a perfect square on the average three-high mill. For a 2 in. round, a $2\frac{3}{16}$ in. square is required. If the square is $2\frac{11}{64} \times 2\frac{13}{64}$ in., after the bar has been passed through the $2\frac{3}{8}$, and then the $2\frac{1}{4}$ in. pass, this latter pass will have a tendency to pull or turn down. The $2\frac{1}{8}$ in. groove being filled will also pull one way or the other, depending on which direction the extra cross-section is started into the round passes. This assumes, of course, that the finishing rolls are plumb and are not eccentric. To overcome the condition of the square being off, an experienced hand round man will enter the bar slightly angular to the perpendicular centre of the pass, as shown in Figure 4. This takes care of the pull exerted by the entrance of a bar of non-uniform cross-section. A good round can be made in four passes provided the man guiding it through is expert in entering each pass with the bar turned up to the exact 90 degrees and keeping it there. If any one of the four passes has not been kept in the 90 degree position, a fifth pass is necessary. Some mills have a set rule of no less than five passes, but most companies prefer to have the roller produce a satisfactory round leaving the number of passes to his own discretion, since fewer passes can be used with newly dressed rolls than with worn rolls. Due to requirements of special sizes, it is sometimes necessary to make, for example, a $2\frac{3}{32}$ in. in the $2\frac{1}{8}$ in. groove. See Figure 5. To do this a perfect square is necessary and the finishing rolls must be aligned correctly. To obtain a reasonably good round, it is not only necessary to make 4 or 5 passes but often 7 passes are required. After the first 4 passes, by turning the fifth pass 45 instead of 90 degrees, a reasonably good round can be obtained. Doing this on the fifth pass reduces the high shoulders

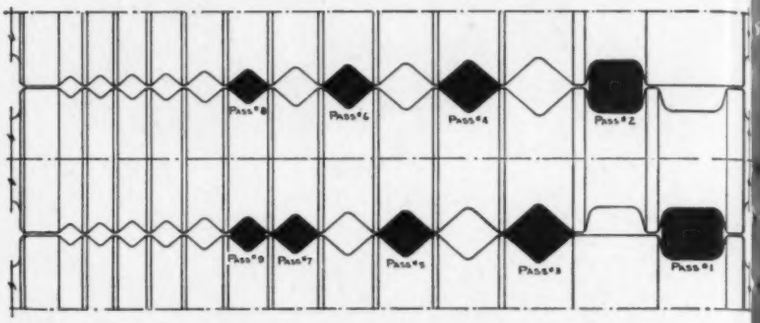
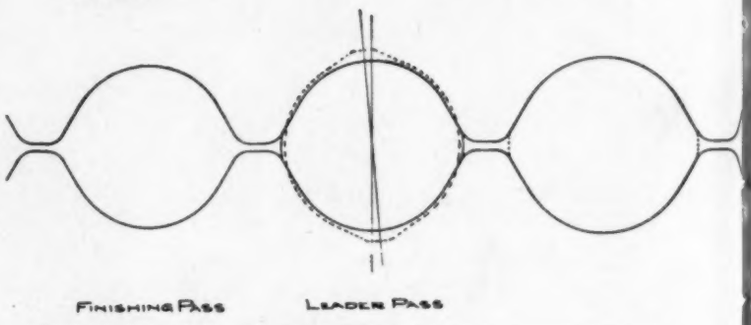


Figure 3 — Roughing rolls showing double pass square to enter hand round roll.

▲

Figure 4 — Entering the bar at the described angle is a temporary method for overcoming the pull exerted when the square is somewhat off. This same method can be applied when using two or more sets of rolls, and any one pass is either eccentric or slightly out of line.



caused by the necessity of making the round in the larger radii. This is not a recommended practice but sometimes has to be done.

Most mills producing hand rounds have at least two stands set up, one to break down from the square to the pass ahead of the finishing pass, and the second set is used for the final passes only, as shown in Figure 6. Where a mill is equipped mainly for hand rounds, they sometimes have 4 sets, using only one groove in each set. This assists the mill in having special finishing grooves for special sizes. The opening of a hand round groove is a most important matter. Too little will cause the bar to have flat spots or be an octagon shape while too much opening will produce an oval shape, and more difficulty will be encountered when guiding the bar through the pass. The amount of opening, shown

in Figure 7, depends, mainly, on the amount of draft from one pass to the next. Since the bar overfills each pass slightly, it is extremely important that they be in perfect alignment and that the opening and radii of the corners be uniform, as any variation will cause difficulties in holding the bar upright through the mill.

Another method of producing hand rounds may be illustrated by taking a 2 in. round as an example. The procedure is to make a 2½ in. square, see Figure 8, followed by a flat 2⅛ in. thick and edge through a 2⅛ in. hand round groove, holding the rectangle up in guides set in a rigid guide box, and finally enter the bar directly into the 2 in. finishing groove. This final pass can be controlled by the lead pass in the first set by moving the top roll slightly in the direction the section is laying or pulling. This eliminates several passes and requires less expert tongsmen to produce a good round. It also increases production and gives a cleaner bar due particularly to the flat and edging passes. This method is advantageous on mills that are working hand rounds with a tonnage above average. On small orders, where only a few bars on each size are required, time for set-up and size changes offsets the advantage.

To obtain greater production, hand rounds in some mills are made on a three-high stand such as that shown in Figure 9, using all three rolls. This eliminates the idle pass over the top roll which is necessary when using two rolls. Plants that have a reversing two-high mill are very successful in the producing of hand rounds as each pass is a working one. However, mills with large tonnages available have advanced to the guide round method, mainly because the accuracy of the former method is not consistent, due to the physical skill required by the man holding, or guiding, the bars through the rolls.

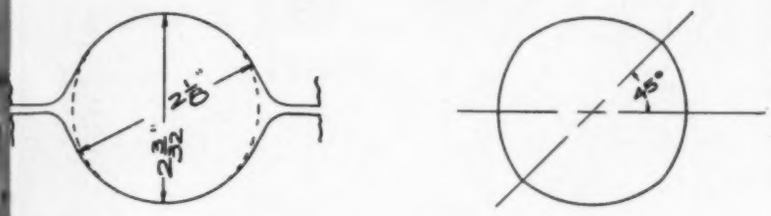
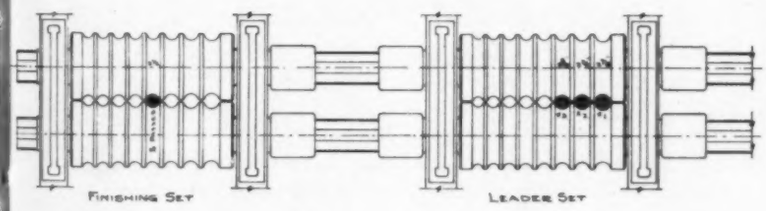


Figure 5 — On the left a 2 3/32 in. hand round is shown in a 2⅛ in. groove, and on the right is shown the shape of 2 3/32 in. rod before turning 45 degrees in a 2⅛ in. groove.

▲

Figure 6 — Duplicate sets of hand round rolls.



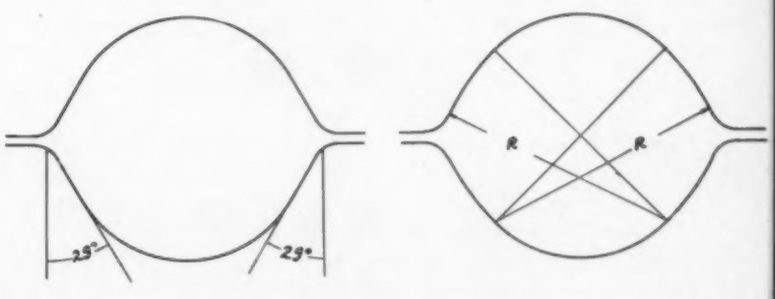
HAND ROUND DELIVERY GUIDES

Delivery guides have always been an important item since each groove is a finishing pass. A different delivery is obtained when working one pass in the lead grooves and 4 or 5 in finishing grooves. Extra long delivery guides are essential in addition to an adjustable entry rest bar, or roll, such as that illustrated in Figure 10, which can be raised after each pass through the finishing groove. This arrangement, complete with roller, bearings and adjustment screw, can be anchored either in the rest bar slots or on the outside of the housing. Another method is to use a long wedge under the finishing guide which is inserted a certain distance and raises the guide after each pass, as shown in Figure 11. An adjustable delivery rest bar, shown in Figure 12, can also be hung from the housing cap having a ratchet wrench or spanner on the top end of hangar rods. After each pass through the finishing groove, the rest bar and guides can be raised to obtain a straight delivery. When making large hand rounds on a mill equipped with tilting tables, the delivery can be controlled by the table operator, but it is more difficult to obtain a uniform delivery from bar to bar.

GUIDE ROUNDS

The person who originated the idea of a guide round probably never received the credit due him from the steel industry in general, or from the rollers and millmen in particular. You are especially convinced of this when you consider the increased production and increased yield, compared with the hand round method, and also because of the fact that less labor and less physical skill are required. Rounds are usually a topic of discussion with mill men, more so than other sections, since most all plants with rolling equipment produce rounds and most rollers, during their career, have rolled a round within the very close tolerance of 0.002 in. and perhaps have such a sample in their possession as

Figure 7 — On the left is shown a straight opening and on the right is shown a curved opening.



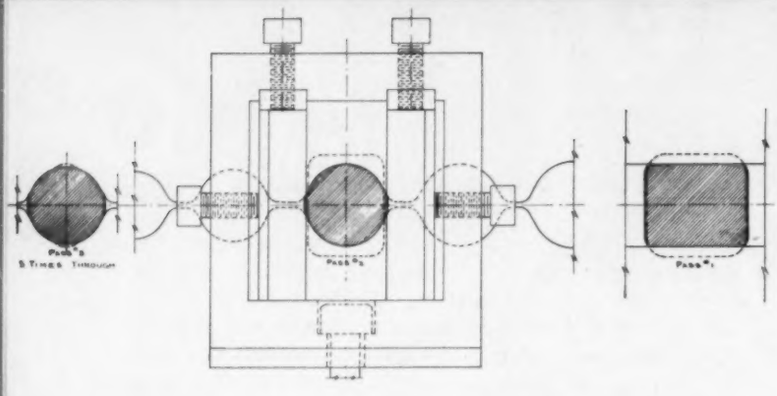


Figure 8 — One set-up used for producing hand rounds

indisputable evidence that they have mastered their craft.

Producing rounds with an oval held by guides inserted into a box or holder is far different from producing squares, hexagons or other sections with flat planes or corners that tend to hold the bar in position when passing through the rolls. See Figure 13.

FINISHING GUIDE BOX ASSEMBLY

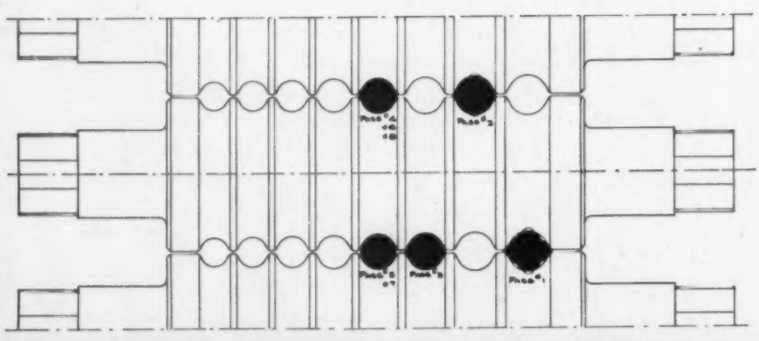
The finishing entry guide assembly is probably the most important single piece of equipment used on a mill rolling rounds. Many types of guide boxes are used and today the engineers, as well as the rollers, are experimenting with adjustable, self-adjusting and even motorized entry guide equipment in an effort to improve the finished product.

In rolling small rods and rounds up to 3 in. diameter, either a roller guide or dependable, adjustable wedge, shown in Figure 14, or gear-type guide assembly is generally used. However, for rolling sizes above 3 in. diameter, it is the aim of the designer to have a section entering the finishing pass that will be easy to hold in position, with reasonable guide clearance, and without exerting heavy wear on the guide, since frequent delays for adjustment become costly.

In preparing a guide box assembly for the finishing pass, a set bar of the exact size and shape of the entering oval is required to align the guides both horizontally and vertically. Entering guides should be made from chilled iron, or special alloy, with the grooves ground in pairs to a set bar and the base also ground square so that the grooves are in perfect alignment, as shown in Figure 15.

To facilitate fine adjustments, a hanging type rest bar, such as that in Figure 16, with screw adjustments is desirable.

Figure 9 — Using three lead grooves, and entering the first groove on the bottom with five passes through the final groove, the fifth or last pass in the final groove would be completed on the top.



ROLLER GUIDES

Roller guides, see Figure 17, as the name implies, were developed and used in 1932, by Sheridan A. Smith, Hamilton, Ontario, Canada. They consist of an assembly of small, vertical rollers equipped with anti-friction bearings. The rolls are grooved and coated with wear resistance material and are finish ground to suit the shape of the bar to be guided through the mill.

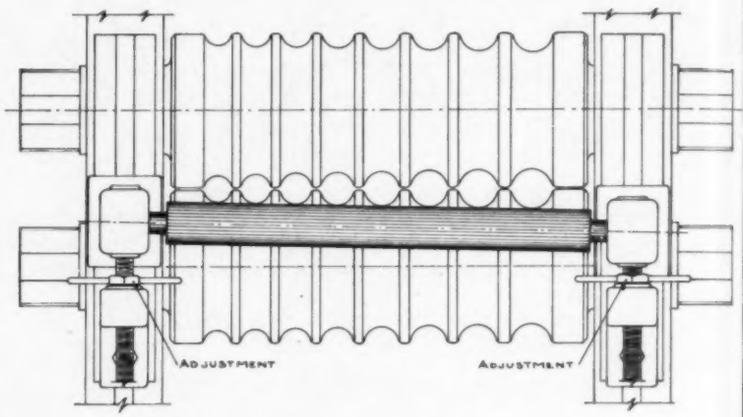


Figure 10 — Adjustable entry feed roll assembly.

Some plants have installed roller guides on the finishing stand only, and others have gone as far as to equip all stands where an entry guide is found necessary.

The main advantages of a roller guide for rolling rounds are long life, freedom from pick-up or scratching the bar, and the wide range of sizes, as shown in Figure 18, that can be rolled through the set.

Since there is very little wear on roller guides, they will run for several hours without any intermittent adjustment. However, it is considered good practice to have duplicate sets available for quick changing when found necessary.

It is important to decide, when considering the use of roller guides, to what an extent it is practical, or desirable, to become equipped to produce and maintain roller guide equipment. It does require better than average skill, particularly with regard to the economical

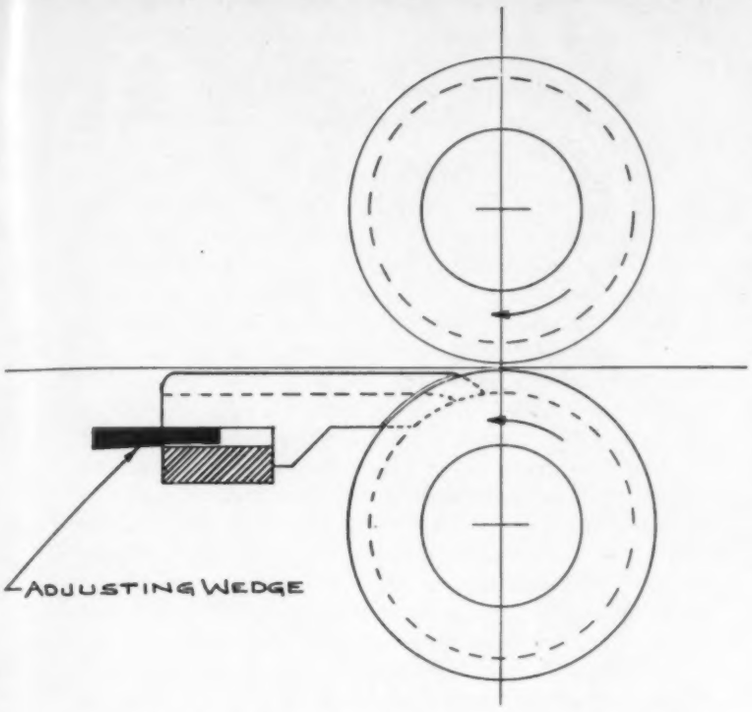


Figure 11 — Hand round delivery guide with adjusting wedge.

application of the wear resistant material, to accurately bore for the bearings and to finish grind the rolls.

ROLLING PROCEDURE

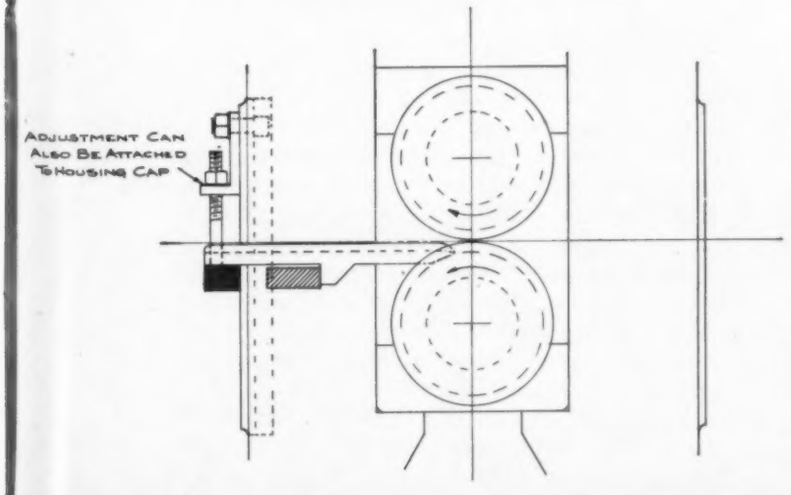
In planning to produce a round, there are certain definite steps which must be followed in determining the production procedure. The decisions that must be made are, first, the size of square necessary to make the round; second, the correct distribution of draughts throughout the train of rolls down to the proper amount of stock required to produce the finished round. See Figure 19. In setting up the mill, it is extremely important that the rolls be aligned as accurately as possible. This is accomplished, on small rounds by eye, and with large sizes, inside calipers are used.

Regardless of the precautions taken in aligning a set of rolls when setting up the mill, once the rolls are in motion and trial pieces put through, certain things happen that cause the rolls to get out of alignment, and this requires the roller to make necessary readjustments from stand to stand, starting with the first and correcting each one until the final pass. These adjustments, on each stand, consist of aligning the rolls, obtaining the proper stock for each pass, and adjusting the entering and delivery guides.

The sizing is done by use of trial bars, usually short billets of scrap material. Where a number of grades are made, the roller has to estimate, from the results of the trial bar, the adjustments to make for the first bar of regular stock.

After this is accomplished, the finishing entry is then the point that requires careful attention and adjustments, at intervals, to produce a round bar. At this point, we assume that all other precautions have been taken. Each pass must be filled with the right amount of stock to assist in holding the bar without depending on the entry guides to do the work. Too little stock puts more work on the guides and also causes poor surface. Too much stock will cause the passes to be overfilled. However, almost every mill has the condition, at times, of too much stock for the roller's comfort, due to certain sizes being on the edge and, in some cases, it is hard to obtain enough stock and, with other sizes, it is difficult to keep down. This latter condition causes constant watching, and the job of making a good round very difficult especially with large tonnages. A small amount can be rolled without too much difficulty. Take the example of a mill rolling ¼ in. round and set up with the proper stock all through the line, and consider that finishing to ¼ in. round requires the smallest line of passes, shown in Figure 20, consisting of ovals and squares. Then an order is required for $\frac{15}{64}$ in. rod, a finishing groove is turned, and the rest of the line of grooves is pulled together reducing the stock

Figure 12 — Hand round adjustable rest bar.



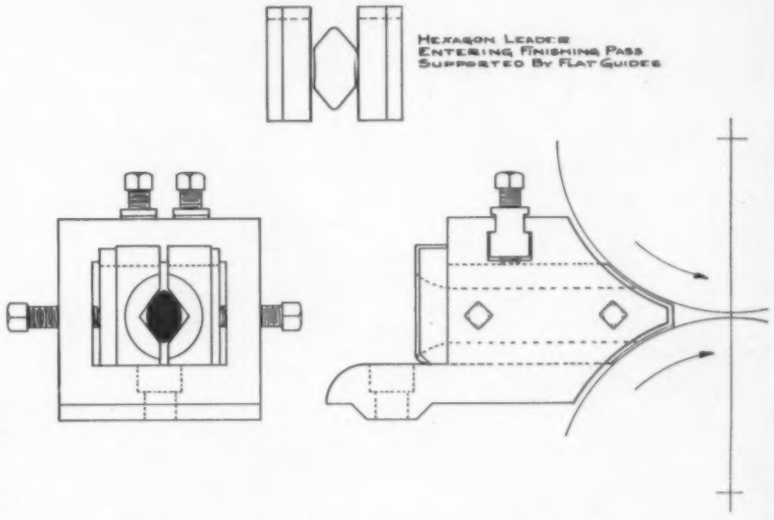


Figure 13 — Finishing entering guide box assembly for guide rounds.

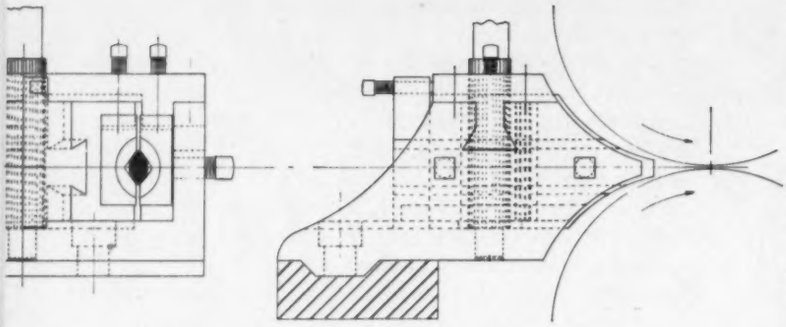


Figure 14 — Adjustable wedge type guide box.

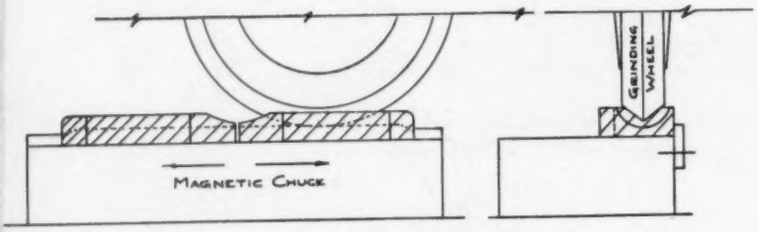


Figure 15 — Guides should be ground parallel on the base to facilitate correct alignment when grinding the grooves.

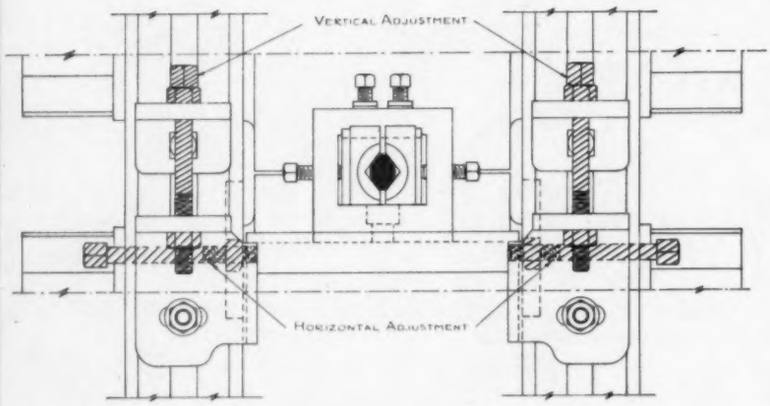
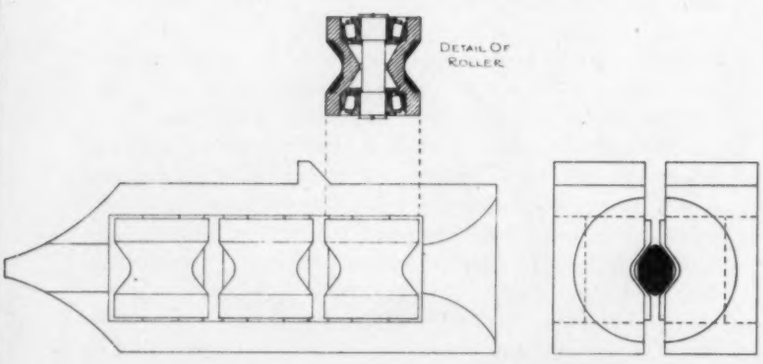


Figure 16 — Adjustable entry rest bar.

▲

Figure 17 — Roller guide assembly.



to obtain the $\frac{1}{64}$ in. smaller rod. This condition makes it difficult to produce this rod, since every groove is filled to the limit and requires continuous attention and careful adjustment on each stand to prevent the grooves from getting over filled. On certain types of products, this practice will not produce a satisfactory surface at all.

Continuing with the rolling procedure, the manipulation of the entry box assembly and the finishing rolls is important. First, the oval must be held perpendicular to the horizontal plane of the rolls at exactly 90 degrees.

Let us consider several typical conditions that occur frequently in the rolling of rounds. In the first instance, we will assume that the oval is exactly vertical and the finished round is delivering with a shoulder on the inside (the term 'inside,' on most mills, is the drive end), and the round is also delivering with a twist toward the outside. This denotes that the top finishing roll must be adjusted against the top shoulder and this is accomplished by slackening the top roll on the outside and tightening on the inside, as shown in Figure 21. It is advisable for the roller to consider at the same time, by observation, whether the bar is full on one side or the other before adjusting the roll as described above. Should the bar show full on the inside, the roller should then reverse the procedure and adjust the bottom finishing roll toward the inside, which will eliminate the shoulder and assist in centering the bar in the groove.

Let us consider another condition where the finished round has a shoulder on the inside and the bar is twisting in the same direction with the oval leaning in the entry guides, also toward the inside. The procedure here is to raise the outside entry guide by inserting a thin liner, as shown in Figure 22, sufficient in thickness to force the oval to ride in a direct perpendicular position. This will eliminate the shoulder and the twist, providing the rolls are not eccentric. Should the rolls be eccentric, the twist will not be eliminated even though you may have a uniform round with the oval riding straight. However, with the rolls eccentric, a certain amount of pull is exerted which, in turn, causes a twisting action on the oval leading into the finishing pass. This causes unequal pressure on the entry guides with a cutting action on the top bearing surface of one guide and the bottom bearing surface on the opposite guide. Note Figure 23. This again will cause the oval to lean and must be straightened by inserting liners under the guide.

Should the top roll, on the outside end, be off-center towards the entering side of the mill, a pull will be exerted forcing the oval to lean toward the outside which will eventually wear or cut the entering guides. Should the roll be off-center toward the delivery side, the same action will occur in the opposite direction.

Through the use of a plumb-line, held at the end of the finishing rolls, it is possible to determine the distance that the rolls are off-center. Another method is to use inside calipers to measure from the roll neck to window of the housing. Also, a third method is to use a parallel bar, the length of which is the same as the finishing rolls and this is placed against the end collars. The latter method with the parallel bar, illustrated in Figure 24, will show which end of the roll is not plumb, without checking both ends, which is

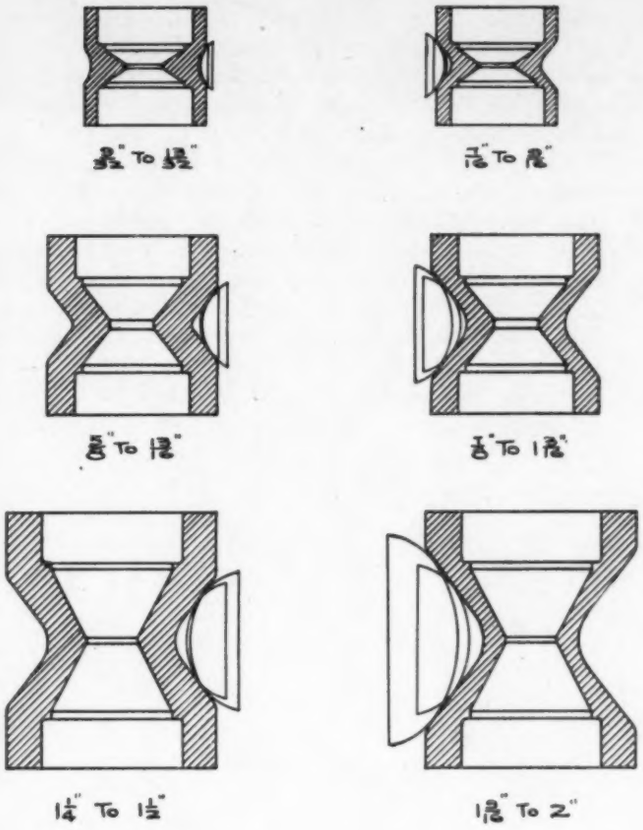


Figure 18 — Six sets of roller guides for rolling guide rounds from $\frac{9}{32}$ in. to 2 in. diameter.

necessary with either of the other methods.

This off-center condition is caused by unequal wear of the bearings, when one side is less in thickness than the opposite side, as shown in Figure 25. Excessive rolling, on one end of the roll, causes unequal pressure and wear of the bearings at that particular end. Chocks that are not machined to the proper dimensions also cause this condition.

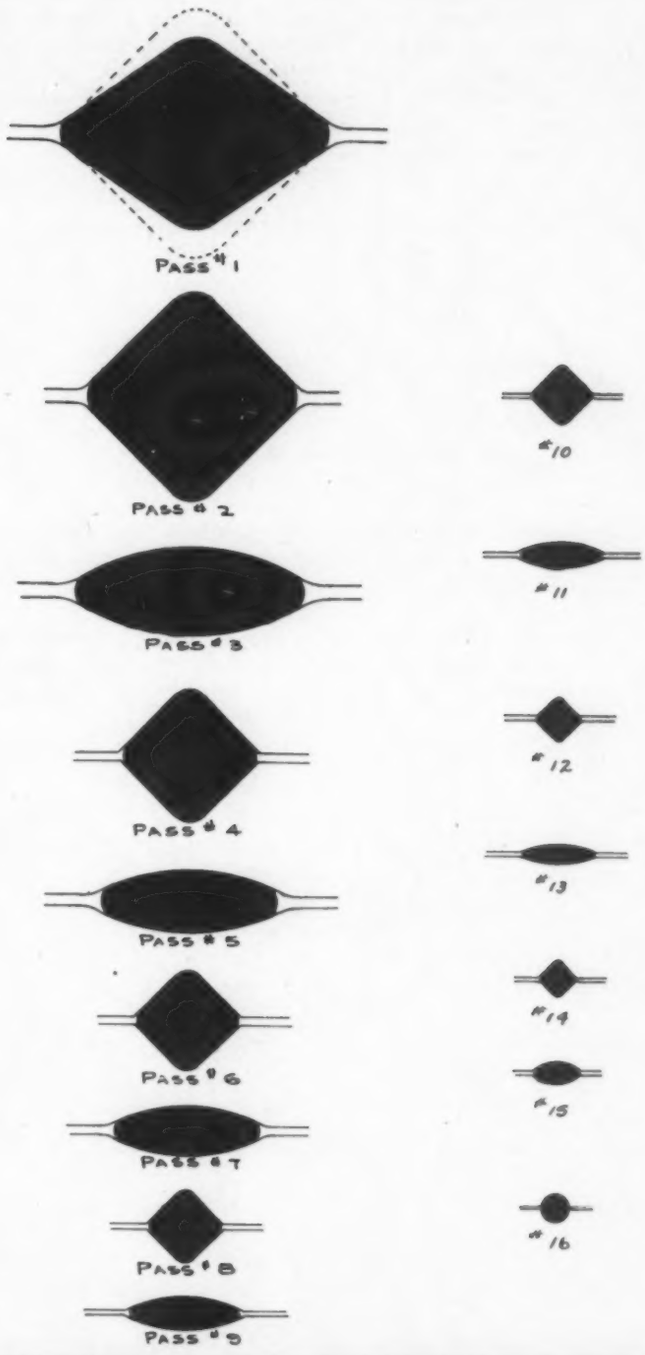
Checking the roll stand for this condition, when assembling or changing rolls and making the necessary corrections, if they are found out of line, will eliminate delays and insure a uniform round with less guide wear with the resulting frequent readjustments.

FINISHED ROUND GROOVE

It is sometimes a problem for persons not directly connected with rolling mills to understand the complications involved when changes in rolling tolerance are contemplated. For example, anyone not familiar with the details might assume, in rolling a 1 in. round, that to provide for a change in tolerance from plus or minus 0.009 in. to plus 0.018 in. minus 0.000 in. might involve nothing more than raising the rolls, as done in Figure 26.

Once a groove is turned in a roll, the best round the roller can produce depends on the tolerances required, shrinkage allowance and clearance figured for that particular groove. Assuming that the rolls are plumb and the oval riding properly, the roller will then cut a test piece. He first measures the top and bottom of the bar, secondly, measures across the sides or scale break, and finally measures the shoulders reasonably close to the scale break. After measuring the shoulders, the roller can determine the proper size to run the dimensions on the top and bottom of the bar. The top and bottom must be run at the same dimension as the shoulders. For instance, with a 1 in. round and a tolerance of plus or minus 0.009 in., the roller may find the shoulders are 1.004 in., therefore, to maintain a round,

Figure 19 — Line of passes to make $\frac{9}{32}$ in. round from $2\frac{1}{8}$ in. billet.



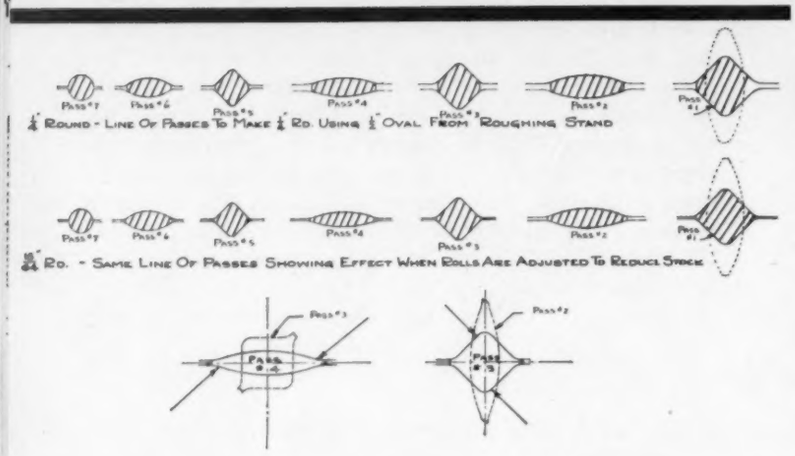


Figure 20 — Grooves are shown slightly overfilled to make $\frac{15}{64}$ in. round. The full square will have a tendency to form a sharp lip on the edge of the oval causing light lines on the surface indicated by arrows, which in turn will show on the finished round. The crowded oval will have the same effect on the square which will carry through to the finished round surface.

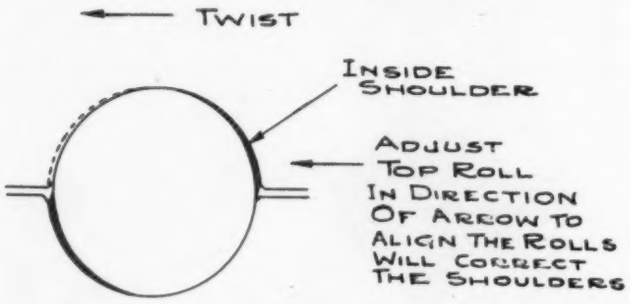
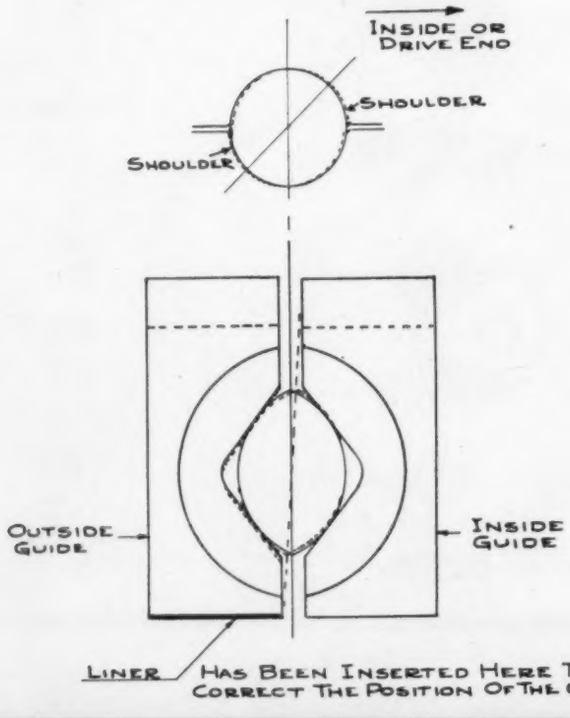


Figure 21 — Sketch showing adjustment required when finished round is delivering with a shoulder on the inside.

▲

Figure 22 — The dotted oval shown leaning toward the inside causes an inside shoulder on the bar, and also causes the bar to deliver with a twist toward the inside or drive end of the mill.



he should adjust the rolls to the extent that the top and bottom will also be 1.004 in. This condition leaves only 0.005 in. on the top side of tolerance instead of 0.009 in. and actually changes the tolerance to plus 0.005 in. minus 0.013 in. instead of the original plus or minus 0.009 in. The same disadvantage is encountered should the groove be 0.996 in.

The roll designers are able to determine, very accurately, the shrinkage and opening necessary to produce a round to finish at a certain temperature. However, on alloy steels, some are required to be finished hot and some to be finished at a low temperature; also customers often request that the rods be rolled on the high side of tolerances. To overcome this, some mills have turned the grooves graduated by 0.010 in., others according to requirements. All this has been done to get the finish size in the middle of the tolerance.

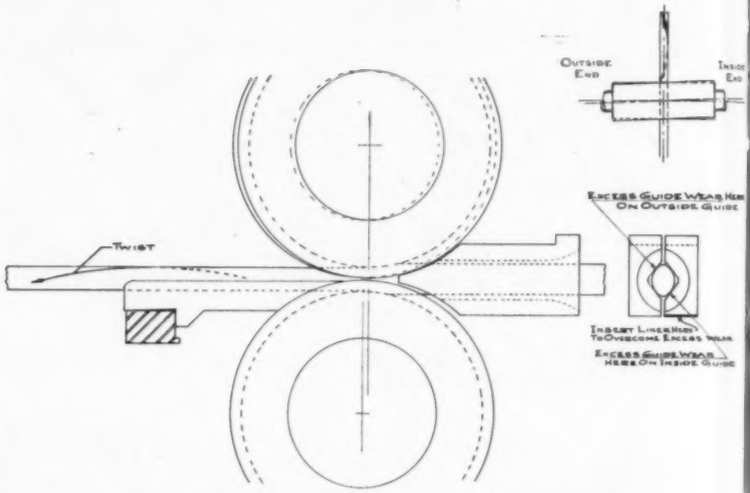
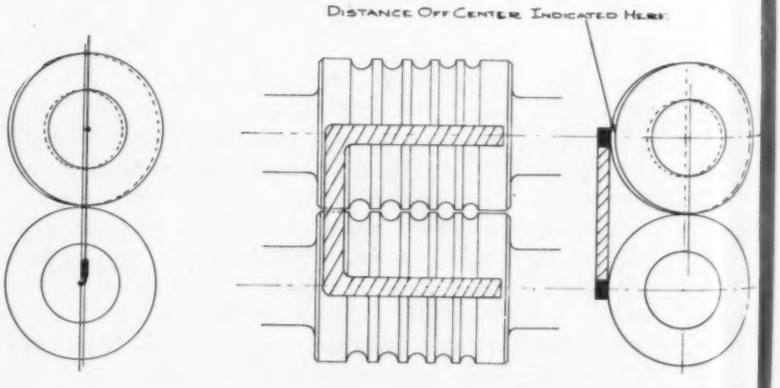

Outside End
Inside End
Excess Guide Wear Here On Outside Guide
Twist
Insert Liner Here To Overcome Excess Wear
Excess Guide Wear Here On Inside Guide

Figure 23 — With the top roll in this position, the bar will deliver with a twist toward the outside end of the mill. To overcome this condition temporarily, a lever can be inserted under the inside entry guide.

▲

Figure 24 — On left is shown the use of the plumb line and on the right, the use of a parallel "U" bar to determine the distances that the rolls are off center.



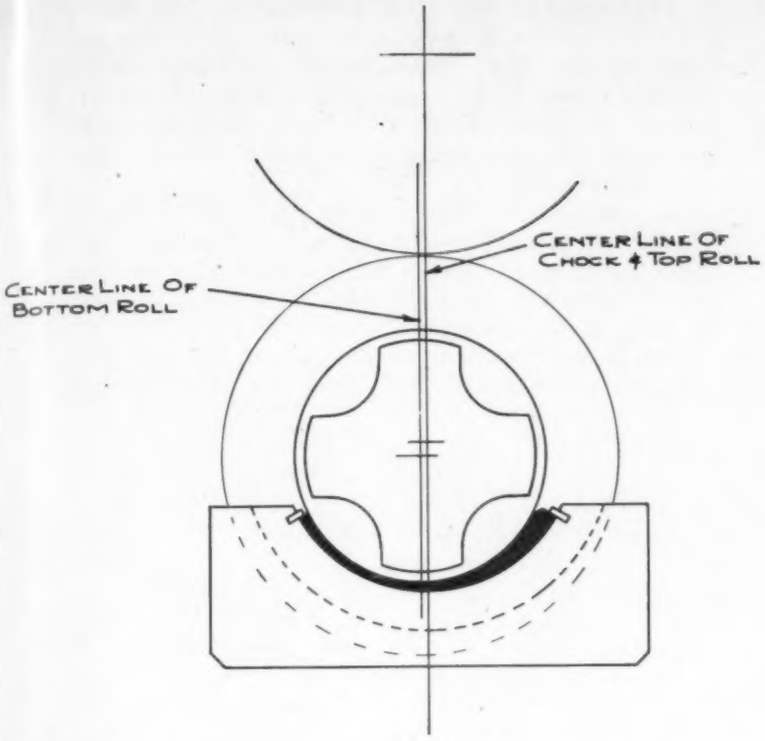


Figure 25 — Sketch showing effect of unequal bearing wear.

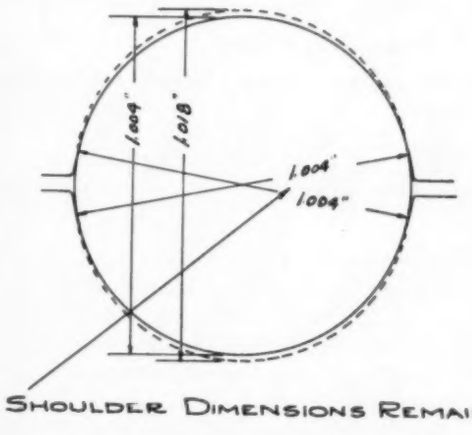
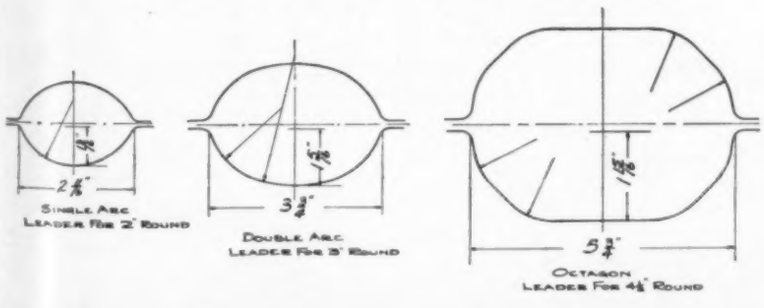


Figure 26 — When adjusting top and bottom dimensions, the shoulder dimensions shown by the arrow remain constant.

▲

Figure 27 — Three types of oval or leader passes.



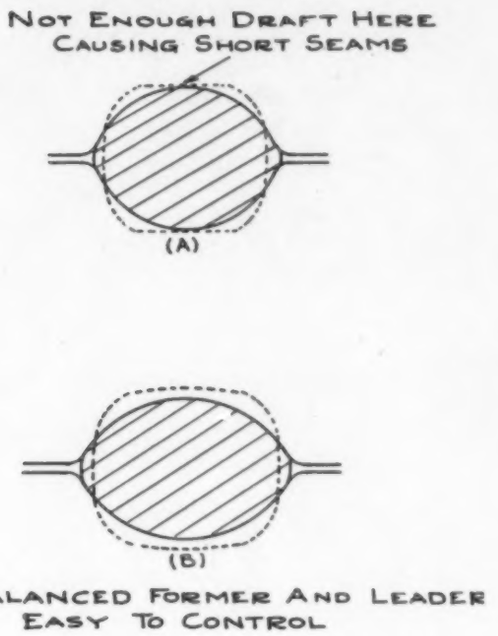
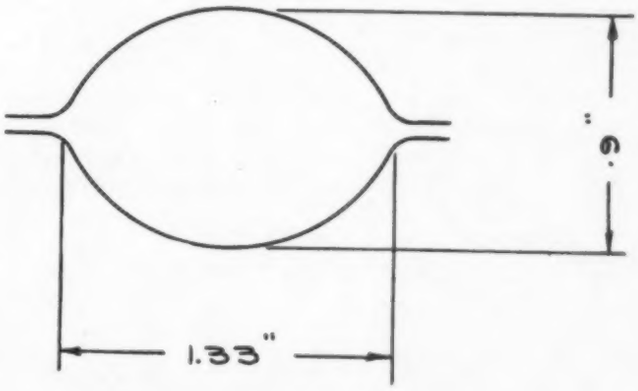
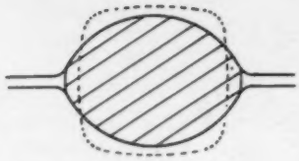


Figure 28 — In the top drawing A, the former section will fill the oval but does not permit enough draft to obtain a smooth, clean surface, and light surface seams can be formed on the open sides of the finished round. In bottom drawing B, former section has the necessary draft to obtain a smooth surface.

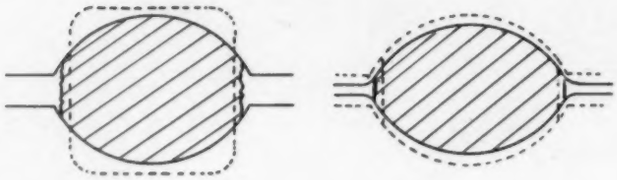
▲

Figure 29 — Typical design for single arc oval.

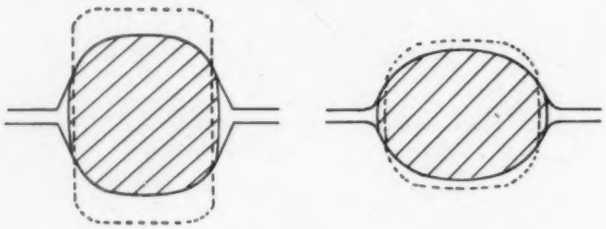




GOTHIC SQUARE AND SINGLE ARC LEADER



SQUAREAND DOUBLE OVAL LEADER

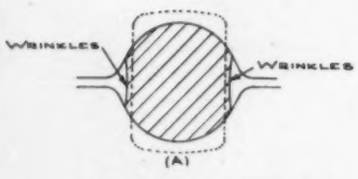


RECTANGLE, DOUBLE RADIUS FORMER
AND DOUBLE ARC LEADER

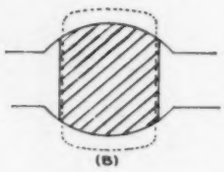
Figure 30 — Several types of leaders.

▲

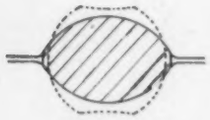
Figure 31 — In the sketch on the left, because of the round contours, the extra metal in the corners of the rectangle are pulled down and have a tendency to concave and wrinkle, which causes oval to be formed with light seams on the top and bottom. In the sketch on the right, the former cleans well but permits no control when leading into the oval. All control is done by keeping the opposite diagonals exact.



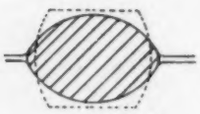
HAND ROUND GROOVE
USED AS A FORMER



OVAL FORMER



HAND ROUND FORMER
ENTERING LEADER



FLAT & EDGE METHOD
USING OVAL FORMER

OVAL OR LEADER PASSES

Many types of oval passes have been designed and used successfully; however, their main function is to assist in the effort of producing a finished round accurate to size, with a minimum of variation. Different designs are usually developed to suit various mill conditions and the size and grade of steel to be rolled, as shown in Figure 27.

Keeping in mind that a leader pass with the least amount of draft will produce the most accurate round, the designer aims to make the oval, so that it can be held upright easily going through the finishing groove, and be readily formed from the preceding one.

It is extremely difficult for the roller to maintain the required section leading into a blunt oval, especially when a former pass is used, as this section would have to be slightly greater in thickness than width. See Figure 28. Therefore, the oval should be wide enough to receive a section that has less thickness than width. With the first condition, the roller will reduce the thickness to the minimum amount necessary to fill the oval. This practice is dangerous on certain grades of steel, as short surface seams can be produced.

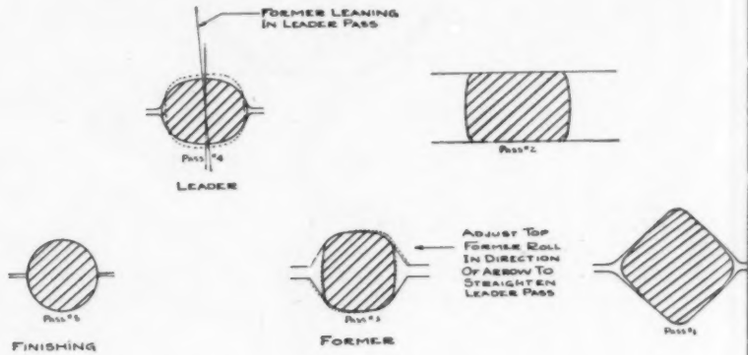


Figure 32 — Double radius former method for rolling guide rounds.

Figure 29 shows a typical design for a regular single arc oval, where the width is 1.33 times the diameter of the finished round, and the thickness 0.90 times the finished round diameter, and modified by increasing the width on small rod sizes and decreasing on sizes above 1 in. diameter. Double arc oval leader passes are widely used and have proven very satisfactory for rounds above 1 in. diameter. This design rides well going through the finishing groove and allows greater reduction in area with less overall draft on the height of the oval.

ROUND FORMER EDGING

At one time, all guide rounds were made by entering a gothic or square into the leader or oval pass. However,

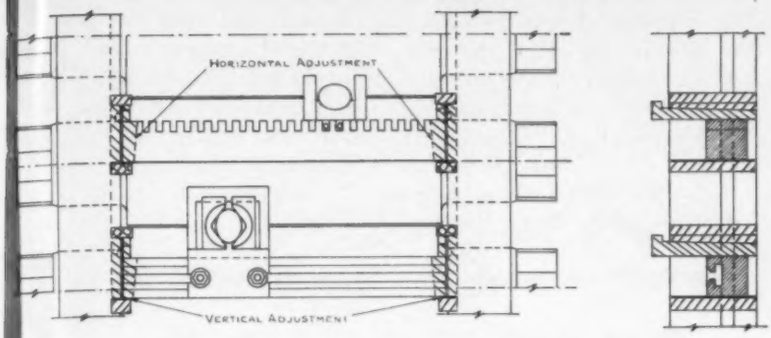
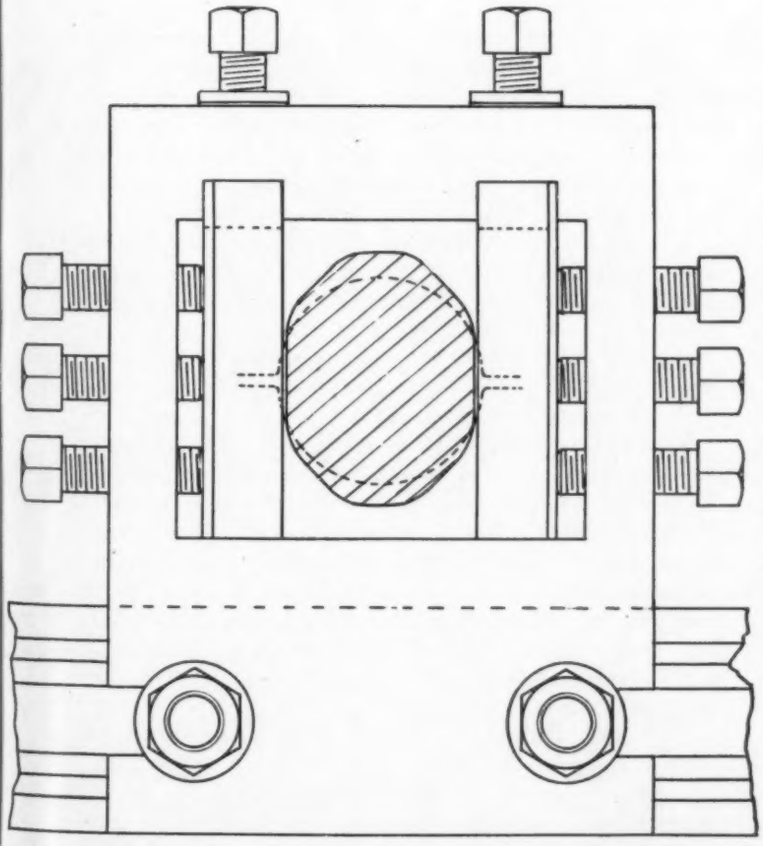


Figure 33 — Heavy duty rest bars with horizontal and vertical adjustment.

on large sizes, due to the difficulty of entering, double ovaling, illustrated in Figure 30, was necessary. This method had a tendency to produce surface seams on the top and bottom of the round caused by the side of the square being scale pitted. The scale pits, due to the action produced on the corners of the square when being formed into the oval shape, formed wrinkles or seams. To overcome this condition and meet the demand for a clean surface, the roll designers and rollers developed the flat and edging method, the edger being a groove shaped to conform closer to the shape of the

Figure 34 — The octagon leader is held with flat guides



oval. This also cleaned the bar and produced a more uniform oval.

One of the first round former edging grooves used in some mills was a set of hand rounds which were reasonably satisfactory. However, on alloy grades this type of former did not clean as well as was desired and was hard to control in the oval due to the round contour, shown in Figure 31. Many different designs of edgers have been used. Some mills used a groove turned with a large radius in the two rolls using the same pass for a large number of sizes. This type proved very satisfactory for cleaning the bar but it was difficult to maintain a uniform section going into the oval.

Mills are now using a double radius former edging with a reasonable amount of opening of around 15

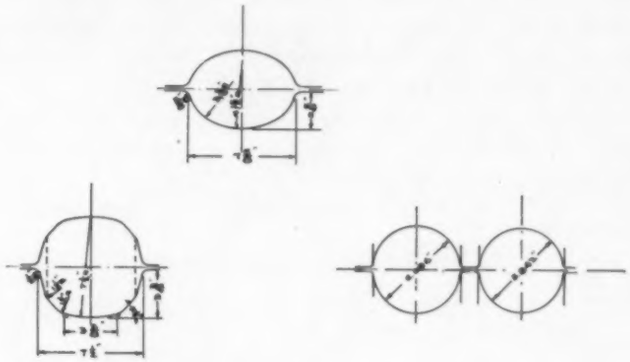


Figure 35 — One former and one leader pass make both sizes.

degrees, the larger radius being equal to approximately 1½ times the diameter of the finished round. This design provides clearance for scale to peel off and still leaves the corners covered, which gives the roller control of the section. The roller knows when he has a rectangle with unequal diagonals entering the former, when this section leans in the oval. He can correct it by moving the top roll of the former edging in the same direction as the section is laying, as illustrated in Figure 32. If the section is being repeated, the top former roll would be thrown in the opposite direction. This is a very important point on the mill as the right amount of stock to make the round is obtained at this point. The amount of stock will vary according to the design of the oval. The narrow and deep oval causes more difficulty in producing a former section that will ride properly, as the shape of this section does not lend itself toward being held with guides. The wider and more shallow oval eliminates this difficulty.

REST BAR AND GUIDE BOX ASSEMBLY FOR LARGE ROUNDS

The rolling of large guide rounds requires special attention to assure a rigid rest bar and guide box, as shown in Figure 33. The rest bar must be held to prevent any movement up or down, or any possibility of

spring or tipping on the point of the box. It is especially necessary to consider this when tilting tables are used for entering.

Long entry guides are a distinct advantage when used in a heavy duty guide box. Guide surfaces are ground on the base in pairs on a perfect oval plug. A heavy design screw box is advantageous for entry but is rarely used on sizes above 4 in. round. When not using the screw box, a bumper of sufficient weight can be used if the mill is equipped with live roller tables. With the use of the double radius oval, however, guide life is not as great as with the single radius oval or octagon shaped leader.

On large rounds from about 4 in. up, the quarter octagon leader, shown in Figure 34, is used very successfully. This type of lead groove is easy to enter and the bar can be held with flat entering guides. It is necessary that the finishing rolls be run with as little clearance as possible since any variation in temperature from bar to bar shows up clearly in the form of a flat plane on the open sides.

An adjustable, horizontal roll placed outside of the delivery guide, to relieve pressure on the guide, prevents scratching and guide wear.

ROLLING PROCEDURE

The principal steps in making large rounds are the same as with the medium sizes. It is necessary to determine:

1. The proper size billet to make the round.
2. That the opposing diagonal dimensions of the section entering the former are exact.
3. That the former pass is properly filled.
4. That the oval is properly filled to insure a straight delivery, with the formed section riding firm and not rolling back and forth.
5. That the oval has equal dimension across the shoulders.

Once the roller has the necessary information and has followed the foregoing procedure, he can then, with manipulation, produce the desired round. See Figure 35.

CONCLUSION

Scientific and industrial development has created an incessant demand for products of improved quality, style and accuracy. Equipment manufacturers have had to be ingenious in combining engineering and science with knowledge obtained through practical application, to design machinery that will meet these requirements. For example, in bar rolling alone most of us are familiar with the ever present desire to eliminate all possible causes of variation so that we may obtain uniformity from bar to bar. Our progress in this respect has been accomplished through improvements in design and equipment such as: extreme care in the design of grooves to give equal distribution of stock; installation of mills sufficiently rigid to eliminate spring; incorporation of bearings to give a minimum of journal and thrust wear; and improved rolls and guide equipment.

And finally, I want to emphasize the vital importance of having the technical representatives of the steel producers continue to maintain constant contact with the consumer. It is through this medium only that the producers are kept abreast with the changes and developments in the many and varied applications of steel. Certainly much credit for past improvements in the physical and metallurgical qualities of steel is due to the technicians of the producing and consuming companies who have cooperated so well to their mutual advantage.

DISCUSSION

PRESENTED BY

LOUIS MOSES, Superintendent, Rail Mill and Roll Department, Bethlehem Steel Company, Sparrows Point, Maryland

ALEX MONTGOMERY, JR., Assistant General Superintendent, Carnegie-Illinois Steel Corporation, Duquesne, Pennsylvania

Louis Moses: After the trial bars are through, the mill and guides properly set, and the rolling going along at production rate, the roller will be observed making an adjustment to the screw or bearing lugs. Unless the observer knows the individual characteristic of that particular mill or section he would question the roller's actions which are apparently at random. It would be found that wear is proceeding at the face of some bearing, affecting endwise adjustment of top and bottom roll registry or perhaps a radial wear of a bearing, or some other looseness which is developing and requires compensation. A good roller observes such incidents and corrects them "on the fly" with his standing rated by least lost time and greater tonnage.

However, he can miss his guess, overshoot the correction, or apply adjustment at the wrong place, resulting in losing one or a number of bars which are off-size.

The point to be made is the difficulty of maintaining a good set-up. You have it for only as long as your bearings permit, and this amounts to a plea for better and longer lasting bearings.

Alex Montgomery: When rolling small rounds on small mills do you feel it is necessary to have high pressure water to remove scale?

C. P. Hammond: It is desirable to remove scale when rolling small rounds as well as larger rounds. Removing the scale with high pressure water between the furnace on the first stand of rolls is the more logical place, as this removes all furnace scale, especially on straight carbon steels, and approximately 75 per cent will be removed on alloy grades containing nickel. We have experienced this with approximately 800 psi of water pressure. With 1000 psi, the cleaning job would be more complete.

In regard to descaling with high pressure water at certain intervals in the mill line, there is a definite advantage where the section is of reasonable size, $\frac{3}{4}$ in. or over. Descaling farther down the line, where the section is small, is of less value, and cools the rod very fast which, on certain grades, is not desirable.

Improvements in Tinning

. . . . vacuum feeding and the use of electrolytic pickling in the tinning operation has reduced hand labor, increased yield and improved quality . . . .

by Howard C. Rodgers

TIN HOUSE SUPERINTENDENT

TENNESSEE COAL, IRON AND RAILROAD COMPANY

FAIRFIELD, ALABAMA

▲ HEAVY manual labor, damage to product and hazard inherent in traditional white pickling of steel sheets prior to hot dipped tinning can be eliminated in the modern tin mill utilizing the cold reduction process. The elimination of white pickling, and in its place the development of vacuum feeding and electrolytic pickling of sheets in tandem with tin pots represents an outstanding advance in tin house practice. It is timely that the art and science of hot dipped tinning should again advance with large strides, prodded as it is by the wartime success of electrolytic tin plate which looms as a serious challenge.

White pickling has long been an important step in preparing annealed steel sheets for tinning. The function of sulphuric acid pickling is to remove oxide formed on the sheet during the annealing.

In the past fifteen years, two developments in the manufacture of tin plate have greatly reduced the burden placed upon the white pickler. One of these is the continuous rolling of steel strip by the cold reduction process which makes it possible to process the steel in coil form through subsequent operations up to the point where it is sheared into sheet form. Inner wraps of the coil are protected from oxidation to a much greater degree than are sheets processed in pack form. The second development is the modern annealing furnace which can be closely controlled for temperature and atmosphere. As a result of these developments, the material now received for tinning at the tin house is in the form of a semi-deoxidized steel sheet with relatively little oxide, therefore not requiring the traditional strong sulphuric acid white pickle.

In the summer of 1941, the Fairfield Tin Mill organization of the Tennessee Coal, Iron and Rail Road Company began searching for some means of providing a feeder and pickler immediately ahead of and in tandem with the conventional tin pot. Utilizing electrolytic pickling experience gained from operation of electrolytic tinning lines, a pickling unit incorporating anodes, conductor rolls and water rinse was developed.

Two units evolved from the original design have been sufficiently successful in their operation during the past year to warrant construction and installation of thirty additional vacuum feeders and electrolytic picklers.

The unit, fed by a two or three pass vacuum cup feeder, is essentially a rubber lined steel pickling and rinse tank which in turn feeds sheets to the top rolls of a mechanical feeder. The pickling current (6-12 volt, d-c, 100-300 amp) is conducted to two steel or graphite anodes, one above and one below the sheet pass line at the center of the tank between two steel or carbon conductor rolls. Sheets passing through the unit serve as the cathode receiving the current through the electrolytic pickling solution (0.5 - 1.5 per cent HCl). The circuit is completed through the steel or carbon rolls operating on both sides of the anodes. Hydrogen evolved on the surface of the sheet tends to remove any oxide from the sheets, and the acid solution completes the cleaning of the surface. Acid is squeezed off with rubber rolls and the sheets pass on through a water

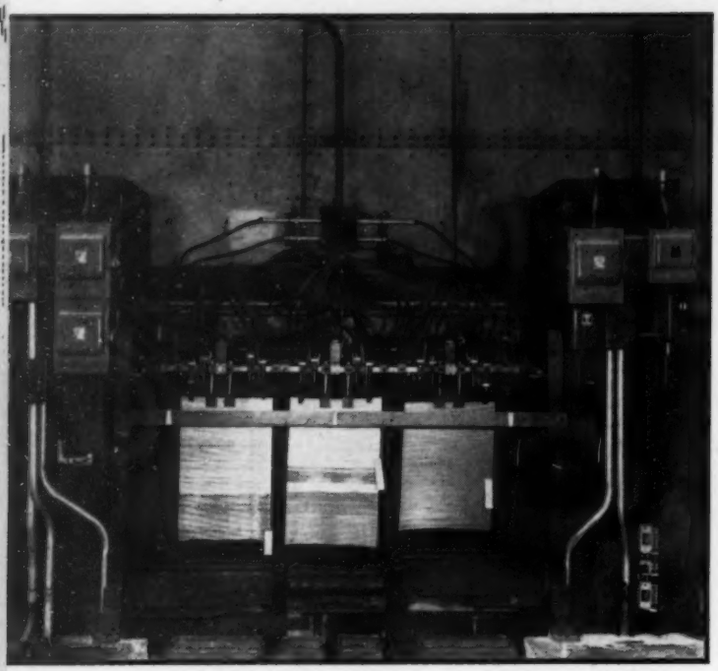


Figure 1 — Entry side of tinning unit, showing vacuum feeder.

rinse and then into the feeder and tin pot for fluxing and tinning.

Special features of the feeding and pickling unit are summarized as follows:

1. Lifts of sheared plate weighing as much as five net tons are placed on the entry conveyor to the vacuum feeder. Lifts are pushed into the feeder and onto a hydraulic hoist in position for feeding. Three to four lifts, depending on size and gauge, will adequately supply one pot for an eight hour turn, as the production from one tin pot is about 15 to 20 net tons per turn.

2. Glass micarta guides set on an angle are used between conductor rolls serving both as guides and insulators, thus preventing the sheets from coming in contact with the anodes. In addition to its non-conductivity and acid resistance, the glass micarta shows greater resistance to abrasion and cutting than plain micarta.

3. Steel or carbon top conductor rolls are partly submerged in the solution and are paired with rubber covered rolls which are on the bottom of each pair. The initial plan to drive only the top steel conductor rolls and idle the bottom rubber rolls was changed to provide a drive for all rolls when it was found that the wet rubber idler rolls would not always turn by friction.

4. The occurrence of dull mottled areas in the coating, known as "leopard spots," on the plates processed on the two experimental units led to the practice of adding a very small amount of inhibitor which reduces the attack on the steel surface of the sheet. The inhibitor also retards the acid attack on the steel conductor rolls, and increases the service life of these rolls from five weeks to over three months.

A considerable saving in man-hours has accrued from this installation by eliminating manual handling of all plate three times, for under this new system it is no longer necessary to load the plate into the white pickling crates, unload it from the crates and load it into the magnetic feeder. Lifts of plate are delivered to the vacuum feeders direct from the shearing lines by fork trucks.

An improvement in yield of product has also been obtained by eliminating these manual handlings which resulted in damaged sheets, numerous cobbles, loss of sheets and a high percentage of menders and waste. In addition, an improvement has resulted in the handling of light gauge sheets, so that the yield of 32 - 33 gauge sheets in large sizes is now as high as that of 29 gauge sheets.

A further advantage derived by the installation of vacuum feeder electrolytic pickler units is that now larger size sheets can be tinned, as the limiting factor in the past in handling large sheets in light gauges was the magnetic feeder.

It is estimated that each loader and unloader on the white pickler manually handles an average of 60 to 75 net tons of plate per eight hour turn. This heavy physical effort has always involved the possibility of more than an ordinary number of strains, cuts and other accidents in spite of constant efforts to provide modern labor saving devices and safety measures. The nature of the work makes for a high labor turnover rate. Consequently, elimination of this operation is desirable from several standpoints. The high turnover rate in labor will no longer be a problem.

This installation will provide the users of tin plate with a better quality of product, since the plate will have a smaller number of kinks and bent edges caused by handling, and a more uniform coating resulting from controlled pickling on every sheet.

Figure 2 — This view of the exit side of the vacuum feeder shows the plate entering the electrolytic pickler.

Developments
IN THE IRON AND STEEL INDUSTRY
During 1946

. . . . this material was prepared by the AISE Development Committee, of which Walter H. Burr is chairman . . . .

▲ AS predicted a year ago, the most difficult problems in the iron and steel industry have been in the field of human relations. Seldom, if ever, in the history of the industry has demand held so steadily at peak levels, and seldom, in the history of the industry, has production varied so widely.

Variations in production were primarily due to labor disturbances, both within and without the industry. Other contributing factors were shortages of equipment (delivery of which in many cases lagged far behind expectations), shortages of coal, ore and scrap, as well as manpower. Another factor which had its effect has been the lowered production per man-hour which has been observed in some locations.

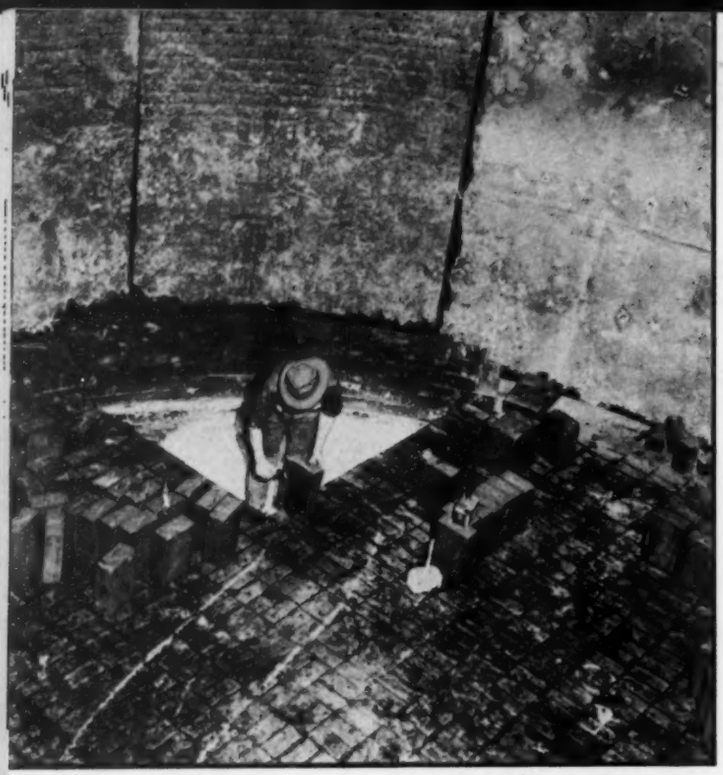
In spite of the troubles, certain trends in the industry have been perceptible. Production has been accented on the so-called light steel products, used primarily in consumer goods such as automobiles, refrigerators, ranges, etc. It begins to appear also that the west is much closer to having its own steel industry than was thought would ever be the case. Foreign countries have been building up their own steel industries, and some which have been formerly dependent on the United States may be on their way to becoming self-sufficient.

In this country, the face-lifting and modernization program which started at the close of the war has expanded and is going full swing. Some obsolete facilities have been taken out of production, new and modern equipment is taking their place — equipment which is more efficient and faster. An example of the latter is the speed-up in rolling mills. In addition, the industry is planning its production equipment to better supply the demand for peacetime goods, which in general are lighter lines.

One debate which has gone on quietly questions whether the iron and steel industry has sufficient capacity to maintain full employment and prosperity in this country. Even if the industry had been able to operate at full capacity for the whole year, it still could not have satisfied the insatiable capacity of the would-be purchaser. The question follows whether this demand is only a postwar condition, or whether it is indicative of future demands. Another question which also comes up is whether present capacity will leave us prepared in the event of a future war. The memories of the unused surplus capacity which was present during the thirties are the chief argument which the expansionists must answer.

WALTER H. BURR
ELECTRICAL SUPERINTENDENT
LUKENS STEEL COMPANY
COATESVILLE, PENNSYLVANIA

At the beginning of the year, the steel industry had planned to invest $327,000,000 during the year in new equipment, exceeding the figure of the previous peak year of 1937 when $320,000,000 was invested. Since the beginning of the year, additional items have been added



Installation of carbon brick hearth in a blast furnace.

to this budget, but some of the projected work will be delayed into next year because of slow deliveries.

By the middle of 1946, sheet and strip capacity were already 1,000,000 tons above the July, 1941, level. By July, 1947, the additional rolling mills completed will raise capacity to 3,500,000 tons above the 1941 level, when shipments of hot and cold rolled sheets and strip totaled 14,570,000 tons.

Shipments of the so-called "light" steel products ran about 45 per cent during the year, and consisted of sheet and strip steel, tin and terne plate, wire and wire products, black plate, conduit and light tubing. This was the highest percentage since 1939.

One of the interesting developments of the year has been the purchase by industry of some of the government-owned steel plants. The largest buyer has been the United States Steel Corporation which purchased the Geneva plant in Utah, as well as a number of plants in the Pittsburgh district whose operations were tied in with existing plants of the Carnegie-Illinois Steel Corporation.

The purchase of the Geneva Plant was an important step in the establishment of a steel industry in the west. It is planned to convert the plate mill into a wide hot strip mill as soon as equipment can be obtained, but in the meantime, the plate mill will be operated. As soon as practicable, a mill to produce hot rolled coils, for a new tin plate mill to be built at Pittsburg, California, will be scheduled. It is expected that the operations of the Geneva plant will promote the growth of other industries, such as fabricating plants, in the area, and diversification of products at Geneva will be dependent on the market. One factor in this development will be probable reductions in the freight rate from Geneva to the coast which is now set at $12.00 a ton. Also important in Geneva's planning is the work which is planned for the Columbia Steel plant at Pittsburg, California, where a new sheet and tin plate mill is now under way.

The Fontana steel works of the Kaiser Company is operating at capacity, and was one of few not affected by the steel strike. Changes in the rolling mills made this year, and scheduled for completion by June, 1947, are a pipe mill for producing one-half to 4 inch butt-weld pipe, and cold-rolling facilities.

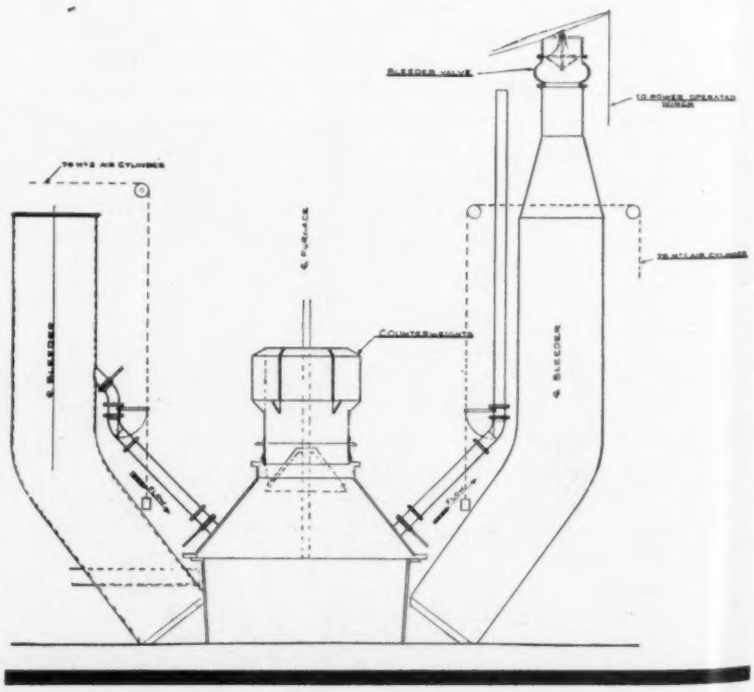
In Seattle, Washington, the Seidelhuber Iron and Bronze Works are planning a steel sheet rolling mill to roll black, galvanized, cold finished and corrugated sheets, and tin plate. Capacity initially will be 50,000 tons annually with planning contemplating an increase to 300,000 tons.

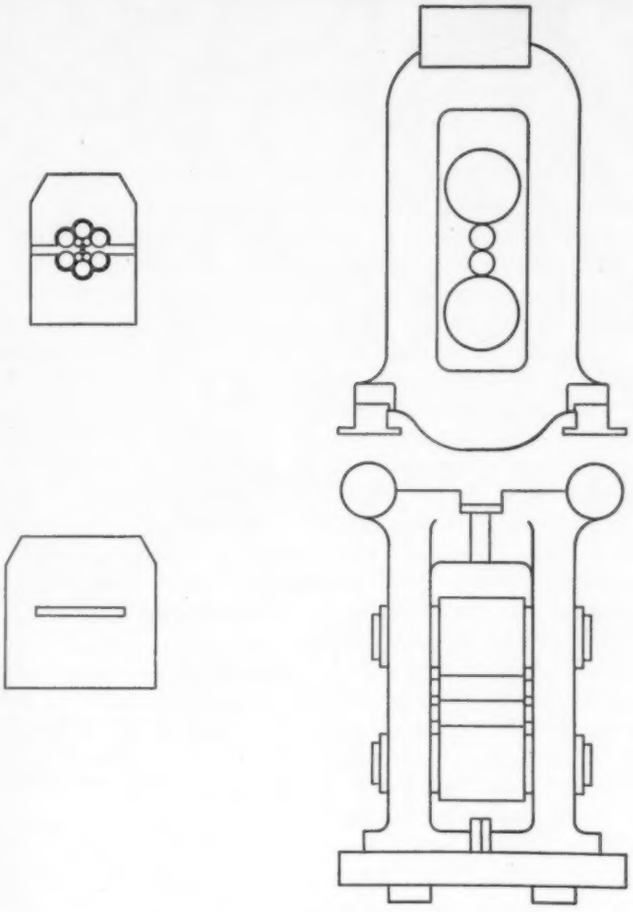
The Bethlehem Steel Company also is expanding its facilities on the west coast, and rod, bar and wire mills, as well as a new open hearth furnace are being installed at the Los Angeles plant.

The east has no intentions of losing its relative standing, and the Bethlehem Steel Company alone has projects in its future program whose estimated cost of completion approximates $190,000,000. At Sparrows Point, a 66 inch continuous sheet and strip mill is being installed to supplement the present 56 inch continuous sheet and strip mill, and to double the capacity of the plant for the production of hot-rolled sheets and strip. A study is being made on the subject of improved facilities for water shipment out of Sparrows Point to handle an anticipated increased volume to the West Coast and export markets. A new blast furnace, a battery of coke ovens and facilities for producing between 45,000 and 50,000 tons of steel monthly has been authorized to support the new flat rolled capacity.

The purchase of new steel plants from the government by the larger companies enabled them to integrate their plants for more efficient production. Also, it enabled them to divest themselves of other plants which

Sketch of top of blast furnace operated under elevated top pressure, showing arrangement of pressure equalizing lines.





General proportions of a Sendzimir mill, weighing 60 tons, compared to a four-high mill, weighing 300 tons, for a 50 in. wide strip. The top figures are cross sections and the bottom figures are the front elevations. The relative sizes of the two mills are apparent.

now might not fit in too well with their scheme of operations. The Carnegie-Illinois Steel Corporation sold their steel works and furnaces at Farrell, Pennsylvania to the Sharon Steel Corporation. The Mingo Works, Mingo Junction, Ohio, were sold to the Wheeling Steel Corporation, who plan extensive modernization and expansion. It will be inter-connected with the Steubenville and East Steubenville plants.

A new steel company, known as the Portsmouth Steel Corporation, was formed to acquire the Portsmouth, Ohio, works of the Wheeling Steel Corporation. The new steel company has contracted to provide several automobile companies with part of their requirements of sheet steel. The Portsmouth Steel Corporation will have an ingot capacity of about 50,000 tons of steel per month.

Disposition of some other government plants is still under way, the effect of which can only lead to further reintegration and consolidation, and perhaps abandonment of some facilities by some of the producers.

One prediction by a steel company president was that some of the steel production facilities in the Pittsburgh district may have to be relocated. He stated, "We must logically expect, that when it is necessary for some of the present steel manufacturing facilities in Pittsburgh to be replaced, they will be installed at locations nearer to the concentrated consumption of steel, and there will be some reduction in the total ingot capacity in the Pittsburgh area."

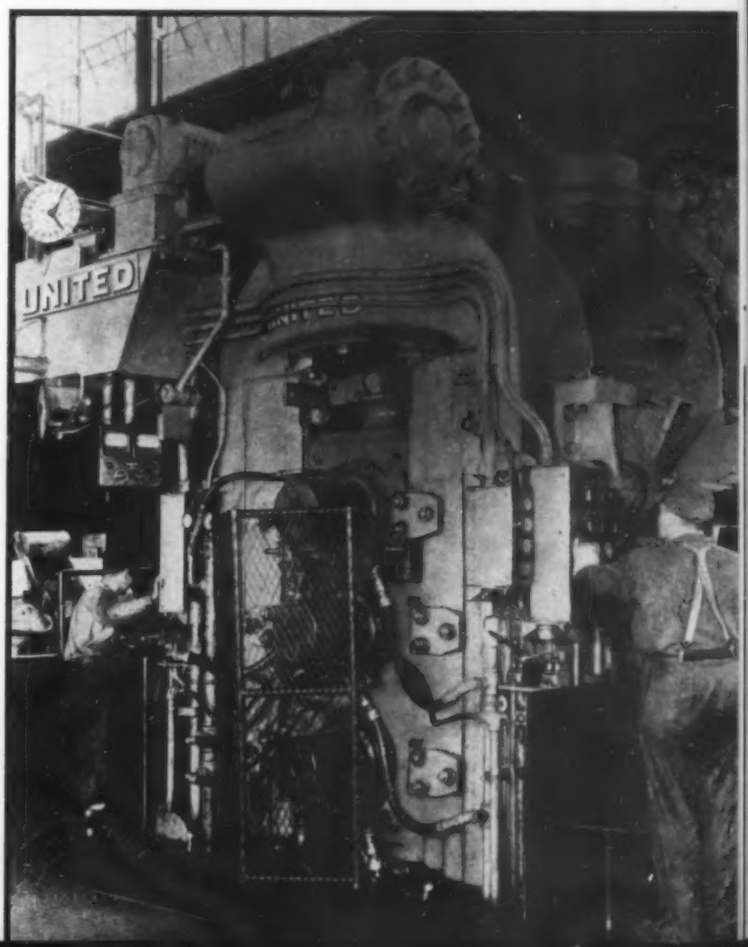
Readjustment and modernization of steel facilities is not peculiar to the United States. In Great Britain, where the government has announced its intention to take over the steel industry, extensive changes are contemplated, and these have been reported in "Modernization and Development Proposals" prepared by the British Iron and Steel Federation for the government. This plan involves replacement and expansion in 7½ years of about 40 per cent of the capacity of the industry at a cost of about $672,000,000.

In South America, steel plants in Brazil are increasing capacity, and proposals to establish plants in Chile are under consideration. In Mexico, work is also under way. Little is known about what Russia is doing, but undoubtedly, the five year plans involve new plants and expansions. According to one story they plan to build their industry to a capacity of over 1300 lb per capita. In India, modernization work is also underway.

What will happen to the steel industries in Germany and Japan is not yet clear, but there is little doubt that they will be reduced considerably in capacity. The proposed capacity for Germany is about one-third the prewar capacity. This policy is based on the recommendations of several commissions who suggest that the ability of these countries to wage war can be limited markedly by limiting the capacity of critical industries to supply minimum civilian requirements.

There is little doubt on looking back at the developments of the past year that steel is still king, and it is

Close-up view of Sendzimir mill.



still the cheapest, most abundant and most versatile of all metals, and its quality and usefulness are being improved. The new steels developed during the war and announced in the past year illustrate this.

One war development which will undoubtedly affect the industry is the introduction of a new steel known as "stainless W." This steel is said to combine the high strength and corrosion resistance of standard 18-8 with hardenability obtained through heat treatment. Titanium is said to be the metal which gives the alloys their distinctive properties. The alloy contains carbon, nitrogen, manganese, silicon, nickel, chromium, and aluminum. The alloy is also magnetic.

Although total steel capacity as given by the American Iron and Steel Institute is down because of facilities taken out of production, much of the decline is due to abandonment of marginal facilities, and the higher rate of production possible in the remaining facilities should result in no net loss. Annual 1946 capacity is listed as 81,236,250 net tons open hearth, 5,154,000 net tons bessemer, 5,500,290 net tons electric, for a total of 91,890,540 net tons; compared with 1945 figures of 84,171,590 net tons open hearth, 5,874,000 net tons bessemer, 5,455,890 net tons electric, or for a total of 95,501,480 net tons. The only component which did not decrease was electric steel. Steel output for the year did not reach the 1944 record peak of 89,641,600 tons, and the tonnage for 1946 was slightly under 66,000,000 tons, which is also less than the 1945 figure of 79,701,624 net tons, as well as the 1940 figure of 66,982,586 tons. Production was off primarily because of the steel strike which brought the production rate down to record lows in January and February, and because of the curtailment in production during the several coal strikes.

Alloy steel output was down to about nine per cent of the total compared with about 12-13 per cent during the war, although it does not appear likely that it will ever get down to the prewar figure of six per cent. About 70 per cent of the alloy steel is being made in open hearths, and 30 per cent in electric furnaces, which latter capacity during 1946 has been utilized only to the extent of 40 to 50 per cent of available capacity.

BLAST FURNACES

Blast furnace capacity increased slightly during the year from 67,313,890 tons to 67,340,590 tons (source American Iron and Steel Institute). These figures probably do not exactly picture the real change, since at the end of 1945, the total blast furnace capacity was about 70,400,000 tons, which capacity included a number of furnaces substantially completed during the war, but never actually put in operation, and some of these facilities which are not normally listed will probably be put into operation, particularly if the scrap shortage continues and demand for steel remains at its high level. In spite of the demand the production of pig iron, ferro-manganese and spiegel fell off for the year and total production for the year was about 45,000,000 tons, compared with 53,454,872 tons in 1945 and 62,000,000 tons in 1944. Strikes and coal shortages were the chief factors in the decline.

One factor of increasing concern to the industry is the prospective future deterioration in the quality and quantity of raw materials.

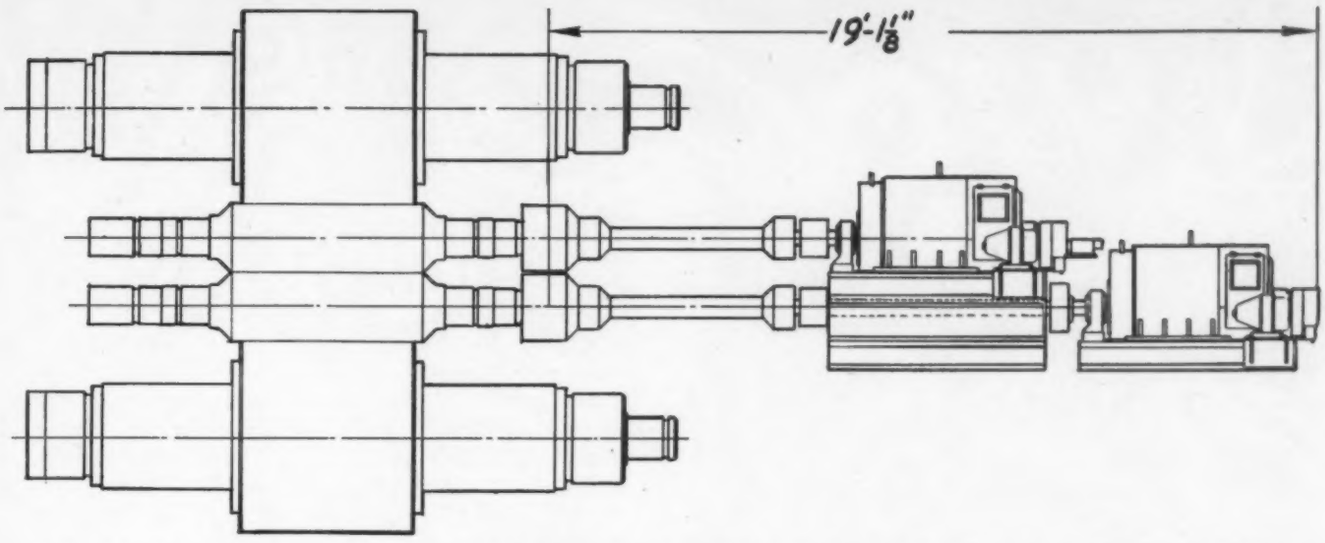
A great deal of study has been made during the year on future ore supplies. Up to the present time, nearly a billion and one-half tons of ore have been shipped from the Mesabi range, and about a billion tons of the same type of ore still remain. However, the remaining ore is not divided among the various steel companies according to their requirements, and some of the companies are finding it necessary at the present time to develop new ore reserves. They can probably manufacture all of the good ore they need from the taconites, and these are being investigated, but if some cheaper source of ore is available, it may not be necessary to go to the expense of processing this low grade of material. The taconite ores in the Mesabi iron formation contain about 30 per cent Fe and 50 per cent SiO_2, and many billions of tons of such ore, or an amount sufficient for hundreds of years, are available. High grade ores in large quantities are known to exist in Labrador, Cuba and South America, and if and when, a deep Saint Lawrence waterway is constructed, these sources may be available to our northern steel plants. Whether the processing of the lower grade taconite ores will be cheaper than the shipment of foreign ores, with their consequent stock piling and political problems, is something that cannot be told at the present time, and will depend a great deal on the results of laboratory and test plant work now being done on concentrating and processing the taconite ores.

Based on present and admittedly scant information, it appears that fine grinding ranging from 150 and 325 mesh may be indicated. Such grinding will require special problems, and operators will probably have to accustom themselves to a decrease in the number of grades which can be met with economy and to large increases in the proportion of agglomerating raw materials. The time is not far distant, perhaps, when benefication and utilization of intermediate and low grade ores will become necessary. The investigations on beneficiating are directed mainly toward the treatment of such deposits as unleached taconite, which material can be made usable by wet magnetic concentration. Non-magnetic hematite requires more complex treatment such as flotation or roasting to convert the oxide to a magnetic form. At the blast furnace many operators are installing their own beneficiating equipment. Ores are graded by screening and the fines are sintered with flue dust to attain lower coke consumption and increased iron production from the charge.

One factor which may affect the future ore supply is the present exploration, which is now going on, of new hematite deposits located in the Algoma mining area. Principal developments at the present time consist of surface tripping and rock trenching at the fault area.

The higher content of undesirable impurities in present day coals requires advanced coal cleaning methods. One of the methods is a heavy, medium separation process in which finely ground magnetic ore in water suspension is used as a cleaning medium. Effective separation of plus 10 mesh coal is attained at specific gravity as low as 1.35.

Some of the most modern coal mines have facilities which provide for sampling, mixing and weighing, so



Twin drive on temper pass mill with special designed motor which eliminates offsetting gears. Motors are 200 hp, 600-750 rpm.

that shipments are of uniform composition and quality. There is an increasing need of such facilities because mechanical mining is responsible for an increase in inert materials in present day coal. For this reason, blending and washing are important to effect reduction of ash and sulphur. The approaching depletion of high grade coals makes it essential that new blends be found. Among the properties of coal on which much research is being done is that of expansion of coal during carbonization. The better coke made from clean coal has shown benefits in tests, similar to the following: coke consumption reduced on an average of 6 per cent, flux reduced about 7 per cent, slag value reduced about 9 per cent, and iron output increased 7 per cent.

By-product coke oven expansion continued during the year. Extensive rehabilitation of facilities, expansion, and new batteries of ovens are under construction. Improved design features such as "saddle" brick walled construction, under jet combustion, and waste gas recirculation, will improve operating practices. New self-sealing doors are a feature of many of the new installations.

One interesting development in the production of gas is a large scale underground coal-gasification experiment which is to be made in Alabama.

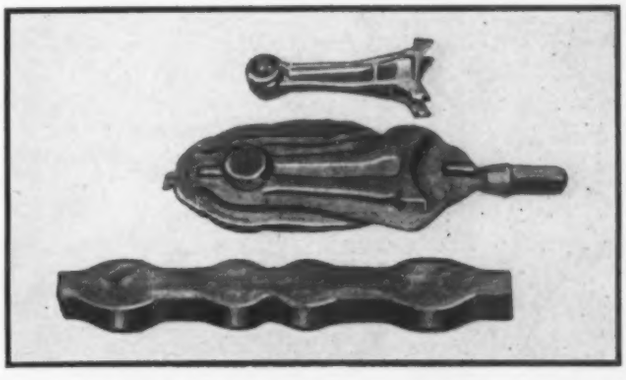
A coal seam is isolated by an open trench and shaft, the coal is ignited at the face opposite the trench, and air pumped in one end of the shaft keeps the coal burning, and forces out product gases from the other end. The Russians have used the method for over eleven years. If the method is successful, it may afford a means of utilizing low grade deposits, not worth mining, as well as lignite and oil shale deposits.

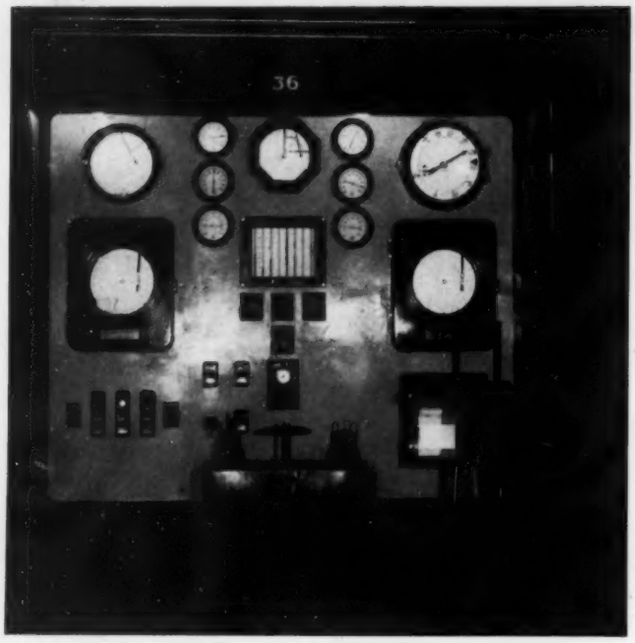
Little further activity has been done by the industry on the sponge iron process, or the direct reduction of iron ore at temperatures below those required for smelting to form metallic iron. However, continuing work is still being done under the sponsorship of the United States Bureau of Mines.

One of the better processes for the production of sponge iron is the Krupp-Renn process which is a modification of the Walz process. Information on the details of this process have recently become available in a captured German report. In the Renn process, air is blown under pressure into the charge, and because of this blast of oxygen bearing gas onto the surface of the charge, there occurs a very brisk oxidation of the sponge metal, which together with a simultaneous combustion of C and CO leads to a sudden increase of temperature in a short length of the furnace. The process may be applied to direct production of steel from pig iron, the pellets being further processed in the open hearth or electric furnace; enrichment of poor quality ore; and production of non-ferrous metals.

Details of furnace construction have changed but little. The use of carbon linings for blast furnace hearths is expanding to many furnaces. Although the linings are more costly than clay brick, they have the advantage of eliminating salamanders and decreasing the danger of hearth breakouts. Carbon has also been used as a blast furnace runner lining with much success and lasts

Three steps in the manufacture of a connecting rod with die rolling; at bottom, blank as rolled; center, forging with flash; top, finished connecting rod.





A modern control panel used when open hearth furnaces are fired on gas-oil mixtures.

longer than the conventional type of runner. The use of such runners also gives a cleaner iron.

From a theoretical standpoint, it has always appeared that operating blast furnaces under top pressure might have appreciable benefits such as reduction in the amount of top gas, gas velocity and dust losses. These principles were put to the test in a modern blast furnace and although many minor mechanical difficulties have occurred in the preliminary work, the work so far indicates that when these mechanical difficulties are finally overcome, elevated pressure operation will prove advantageous whether blowing present wind volumes or increased volumes proportional to the increase in pressure. Flue dust production is in the neighborhood of 90 lbs per ton of iron compared with 350 to 375 lbs under current practice. Top temperature averages below 300 F.

About 10 per cent of the blast furnaces now in operation are equipped to control the moisture content of the blast. A recent survey showed about two-thirds of the blast furnace operators as favoring high moisture content of the blast, and one-third favoring low moisture content.

Several operators are studying the use of oxygen for enriching the blast. Such operation can be had with reduced consumption of fuel and faster smelting, and may eliminate heating the blast. However, the use of oxygen enriched blast has several disadvantages, such as possibility of explosion, and formation of calcium carbide which consumes fuel and flux. Most recent steel applications, where oxygen enrichment is being tried, occur in the open hearth.

STEELMAKING

The open hearth maintained its position as the major factor in steel production. Although the production of alloy steel was smaller during the year, much of this reduction took place in the electric furnace. Over one-half of the open hearths now produce alloy steels.

The shortage of scrap has increased the use of hot metal in the charge. Scrap shortage also has probably been a factor in alloy contamination and about three-fourths of the plants have had such trouble. The ratio of alloy steel made in the open hearth to that made in the electric furnace was about three to one and total alloy steel production averaged around 9 per cent of the total production for the year.

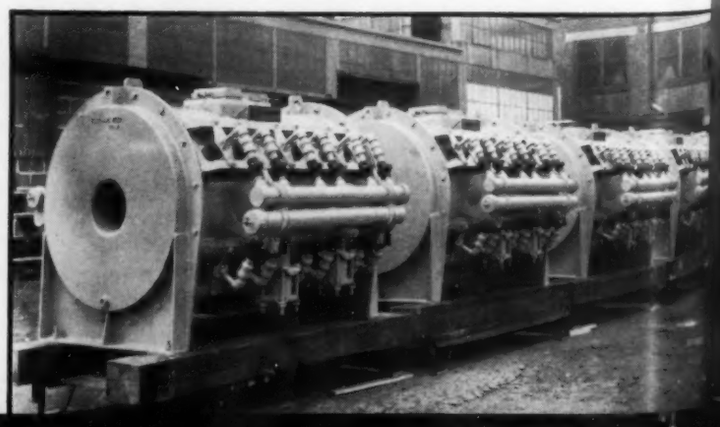
One steel plant in Canada has found that it can make open hearth grades of steel in the electric furnace, just as economically, if not more so, than in the open hearth. The factors in this comparison are, of course, a low power rate and call for some items in the open hearth which are higher at that plant than they would be in some United States plants. On the other hand, a steel plant in the United States is contemplating the installation of an electric furnace in its plant in the belief that it will be more economical than would be an additional open hearth. The reason for this lies in surplus rolling mill capacity as compared with open hearth and pig iron capacity, which make the cost of steel from cold melt steel more economical in the electric furnace.

The conventional basic open hearth furnace has undergone no radical changes in design in the past year. A noticeable trend is evident, however, in the use of liquid fuels such as oil or tar and a corresponding reduction in the number of furnaces fired with producer gas. Much work has been done on pouring practices, and nozzle erosion has been reduced by greater density, stronger mechanical bond and higher refractoriness.

The spectrograph, which has been in general a laboratory tool, is also finding its place on the charging floor. The use of this instrument has enabled the operator to quickly obtain his analyses. For example the direct reading spectrograph is capable of determining analyses of seven elements in three minutes. The spectrograph has also been used in slag control for estimating the lime-silica ratio of steel making slags.

Many open hearth operators are planning to use more basic brick for linings in their furnaces, and some operators are planning to use basic brick for complete linings. Such applications show promising returns in higher allowable operating temperature, faster production, and reduced maintenance. One of the factors in the use of basic linings is that the thickness of the uptake wall has been decreased in the furnaces constructed, so that these walls have been 12 inches thick compared with 18 to 27 inches for conventional silica furnaces. Another advantage is that the slag is much more easily

Rapid heating gas furnace used for annealing or heat treating seamless tubing, rod stock, and stainless steel tubing.



The open-end tube immersion pyrometer in use at the open hearth furnace. The pyrometer is thrust through the wicket hole and forced down through the slag into the molten metal where a temperature reading is obtained in a few seconds.

removable. This consists primarily of iron oxide which makes it suitable for use as a charge ore. The long life of such linings is demonstrated by the experience of a couple furnaces, where at the time of writing, one furnace had a run of 1400 heats, and the other 1000 heats, and the linings are in such good condition that eventual life of these parts cannot be estimated.

A number of novel operating and maintenance practices have helped to speed up production. As an example one company has been able to reduce the time of rebuilds from ten to twelve days to about six days. This reduction in time has been effected by quicker removal of the slag which this plant now removes in about three hours instead of the former six to ten turns. This is done in several ways. In one method a car or a sled is run on two tracks which extend the full length of the slag pocket, and for a distance of 25 feet outside the pocket. The car is loaded with slag and brick and by means of a steel sheave is then pulled by a locomotive out under a pit crane.

Toward the end of the year, a great deal of interest was shown in the possibilities of using oxygen in the open hearth. With the demand for steel at capacity levels, the possibilities of expanding production without having to construct new plants seemed to be too good to be true. At present, the limiting factor seems to be a sufficient supply of cheap enough oxygen.

Large scale tests on the use of oxygen in open hearth furnaces at a steel plant in Canada received much publicity. The oxygen is introduced so as to produce a controlled flame, which is directed at the furnace charge during the meltdown period. The tests already conducted show that scrap melting time can be substantially reduced, and production from existing furnaces can be stepped up appreciably with no expenditure for extra capital equipment.

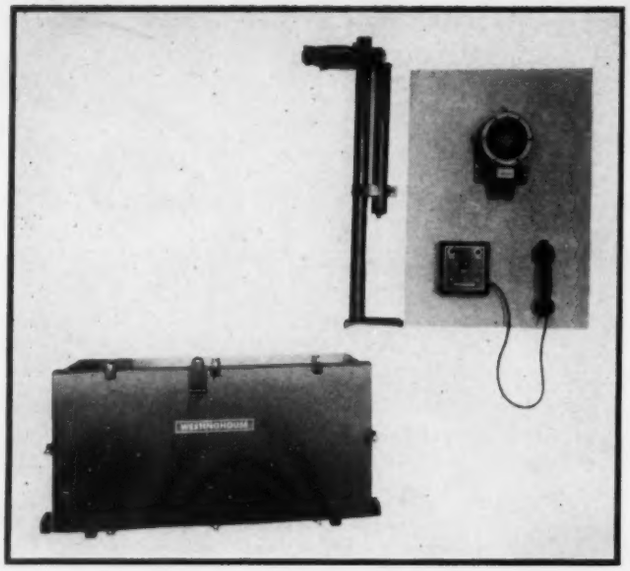
Tests in this plant on the use of oxygen were made by introducing the oxygen into the checkers to replace the regular volume of air used to support combustion. The introduction of the oxygen adjacent to the fuel oil furnished a quicker release of the elements in the oil. The hot flame which occurs with the use of oxygen rapidly loses its heat as long as there is scrap in the furnace, and at this time the intensity of the flame seems to have little effect on the refractories. The most effective quantity of oxygen for firing was about 40 per cent and this mixture with fuel oil gave a fuel saving of 17 per cent, as well as an increase in the life of the furnace and reduction in the amount of brick per ton. Melting time was reduced 2½ hours. With the use of oxygen, furnaces must be charged faster, and larger charging boxes and doors would be required. An increase in the tonnage of the open hearth from 25 to 30 per cent of the meltdown time was found, and use of oxygen in the bath would cut another 10 to 15 per cent off the meltdown time. It is believed that if the furnace cannot be charged in 2½ to 3 hours, the use of oxygen should not be considered. The use of oxygen increased yields, 2 to 3 per cent higher than conventional practice, and iron oxide ranges were reduced to 8½ and 9 per cent as compared with 11½ to 12 per cent in average practice. The oxygen is used until the heat is well melted or for about four hours and is taken off the furnace when the line boil starts. Furnace reversals range from 12 to 14 minutes. About 130,000 cu ft of oxygen is used in a four hour period.

The use of oxygen will require development of many details. A special burner is now used in which the oxygen is passed through the annular space between the oil pipe and outer coaler. This annular space has varied from a width of ¾ to 2½ in. The narrower width of annular openings gives a higher oxygen velocity compared with the oil velocity and gives a better formed and higher velocity flame.

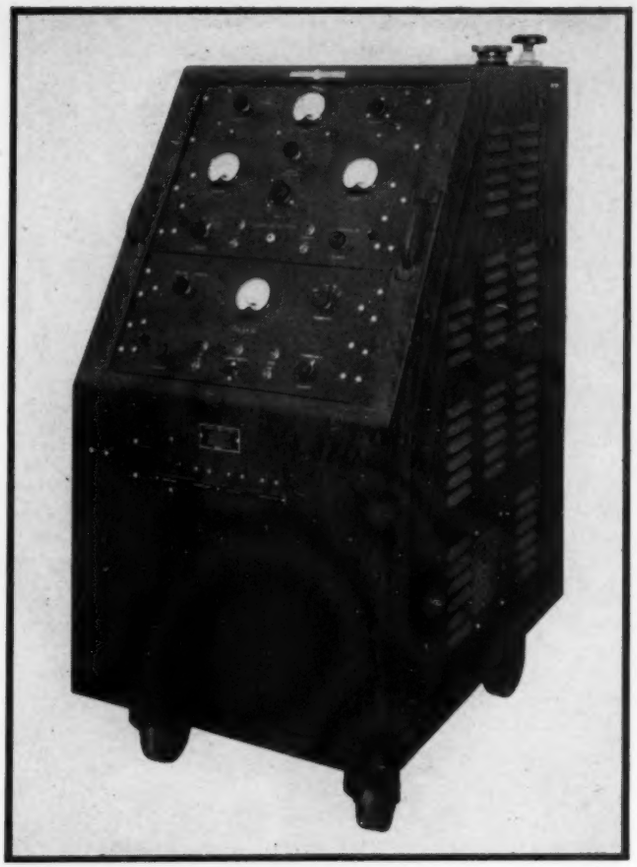
In one steel plant in the United States, the melt time was reduced fifty per cent to six hours from twelve hours.

Oxygen has also been introduced into the molten bath of open hearth and electric furnaces for the reduction of carbon. In one plant, carbon is removed from stainless steels made in an electric furnace by connecting a dried pipe to a special oxygen lance, and this is pushed through the wicket hole in either the side or charging door when the heat is two-thirds melted. The end of the pipe is inserted under the slag and the oxygen turned on. The lance is fed slowly until it gets too short to use, which takes about 20 minutes, and the end is kept just under the slag. Three lances

A new ore stacker. Each ore pile normally has a storage of about 15,000 tons per pile, at this plant.



The radio set shown can be used either in the locomotive or caboose, for communication in switchyard operations.



The leak detector shown is really a mass spectrometer which is tuned for the gas that is being checked. The gas in turn has been pumped into the vessel being checked.

are used in a heat and the three will remove about 0.24 per cent carbon in a normal commercial steel.

In a 67-ton open hearth of another steel plant, 6000 cu ft of oxygen reduced carbon content from 0.58 to 0.09 per cent in 24 minutes.

The increased use of oxygen in the steel plant has led to examination of different methods for preparing oxygen, and many of the steel plants are considering the installation of oxygen plants in order to have the necessary oxygen available for the tests of the use of oxygen in open hearth and blast furnace. Several large oxygen installations are underway. One large unit under construction in Texas (although not at a steel plant) will be operated in connection with the processing of natural gas into motor fuel, synthetic diesel oil, and alcohol. This unit will produce oxygen at an estimated cost of 4.8 cents per 1000 cu ft. One service greatly expanded during the year is that of renting oxygen generators on a lease basis. The generators are installed in the user's plant, where all the oxygen produced is metered and paid for on a volume basis. Economies running as high as 60 per cent are claimed over the use of oxygen in cylinders.

ROLLING AND FINISHING

Perhaps the greatest amount of conversion and expansion work has taken place in the rolling mills. There is probably no company which has not or is not planning to do extensive work in this section of their plant. The emphasis is, of course, on finished mill production. The work so far has, however, been seriously handicapped by the long time deliveries on heavy machinery, construction materials, etc. Work is being done on all types of rolling mills. One of the original wide hot strip mills is being modernized and speeded up, and this work requires new electric equipment for the finishing stand auxiliaries. At one plant, a semi-continuous mill installed during the war is being converted and speeded up to roll hot strip, and two new finishing stands are being added. Rotating regulator controls are being added to many mills to handle the faster operation.

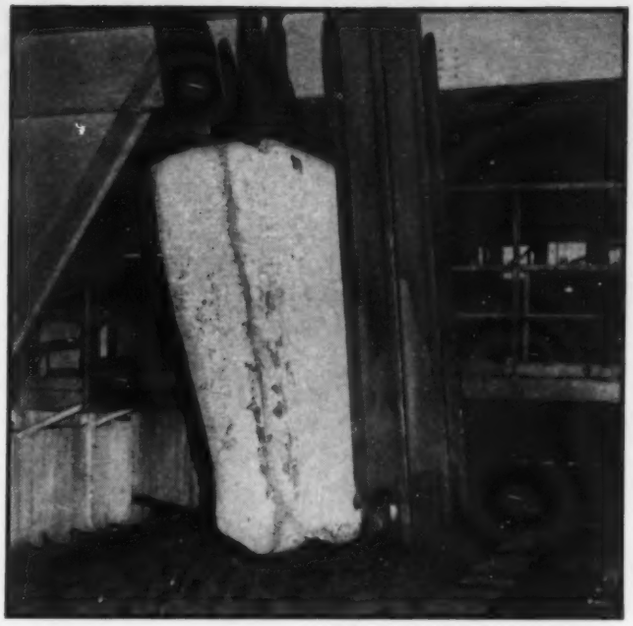
Speed of cold reduction mills is being increased. The individual generator scheme on tandem mills which was recently introduced has now been applied to four mills, three of which have maximum speeds in excess of 4000 fpm. The increased mill speeds diminish the number of step down gears required. The regulating tensiometer has been advantageously used to control the winding reels on some of these high speed tandem mills.

Several Sendzimir cluster type mills are being built for production rolling. One of these mills is a 19 in. mill and the other is a 40 in. mill.

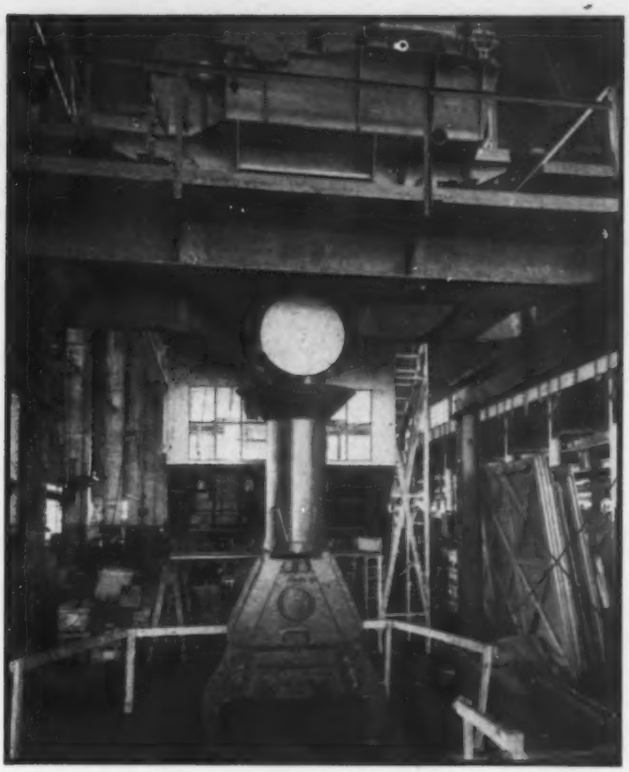
One producer is installing a new 29 in. 4-high reversing cold strip mill to roll stainless steel.

Construction work is progressing rapidly on a 56 in. 4-stand tandem cold reduction mill at an eastern plant. The first two stands are driven through pinion stands by single armature d-c motors running at the working rolling speed. The top and bottom work rolls of stands number three and four are individually driven by means of twin motor drives driven through off-setting gears.

Two 42 in. five-stand tandem tin plate mills in the Chicago district, installed about 1937 and designed for operation at 1200 fpm maximum, are being rebuilt with complete new motor drive equipment to enable opera-



The slab turn-over device can allow one slab to be lifted out of the way, while another passes on the approach table, as well as turn over the slab.



The tong housing is in its highest position in this view of a telescopic stiff leg soaking pit crane. Trolley height is no greater than that of standard mill crane trolley, thus allowing use of stiff-leg where headroom is limited.

tion at delivery speeds up to 4500 fpm. Each mill and motor will be supplied from an individual generator enabling individual stand IR drop compensation and tapered tension control without the use of separate booster generators.

An Ohio alloy steel producer is greatly expanding its facilities for the production of wide stainless steel strip by the installation of a 66 in. single stand reversing cold reduction breakdown mill, and a 54 in. single stand reversing cold reduction finishing mill, designed for maximum speeds of 500 fpm and 700 fpm respectively. These speeds are higher than that at which most stainless steel strip has been rolled before.

At one plant, the billet mill which feeds the bar mills is being rebuilt, using alternately horizontal and vertical rolls in order to eliminate twist by permitting the entrance of the bloom into the rolls without the necessity of turning or twisting in the pass. This same principle is also being applied to a new bar mill at the same plant.

One Ohio producer prior to this time had to ship his semi-finished steel to other plants because his iron and steel making capacity exceeded his finishing capacity, so he is completing a new 48 in. strip mill. The new strip mill is being installed by adding three four-high finishing stands to an existing 84 in. reversing plate mill, together with coilers and coil conveying equipment. More than one-half of the anticipated production will be skelp for making electric weld pipe.

A Mexican steel producer has been constructing a new rolling mill near Mexico City. Equipment to be installed includes a 30 in., a 21 in., a 16 in., a 14 in. and a 10 in., 6 stand continuous mill.

The constantly increasing demand for metal sheet strip and plate of all kinds has required that rolling speeds and accuracies be greatly increased, and one solution led to the development of the Sendzimir and other cluster type mills. Principles for the various mills are different, but they attain the end result of great reduction per pass, lower power cost, greater accuracy (in cold strip 0.0001 to 0.003 inches is not unusual) and greater speeds (5000 to 6000 fpm).

The same type of progress has been made in wire drawing. Its producers can now draw wires in quantities to a diameter of 0.0001 inches or less. Most of the improvement is due to improved die equipment.

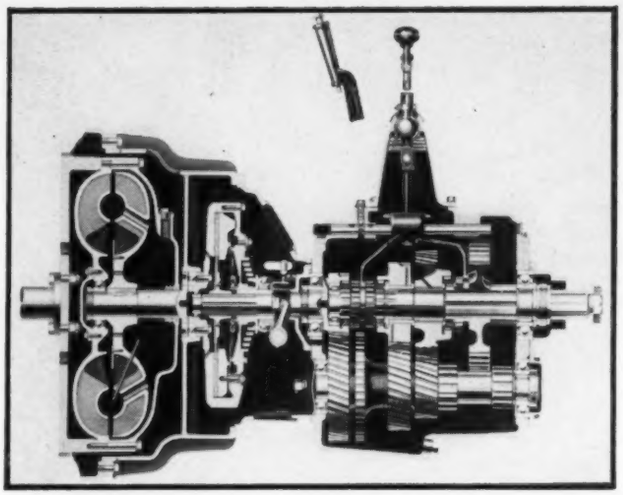
One item for which there is an enormous backlog is pipe, and this has been reflected in the large amount of expansion in pipe making facilities which is now under way. The largest tube company is not only expanding its pipe making facilities, but increasing the steel capacity at one of its plants about 20 per cent. This company has scheduled for installation at this plant the first continuous seamless pipe mill. A continuous rolling process will be installed to turn out long lengths of steel pipe without welds as fast as 2000 fpm. This process combines in one step most of the conventional operations. After the normal conventional first piercing operation, the new mill will process the shell through a nine-stand continuous rolling mill and will operate as a straight line production unit. The new mill is designed to make seamless products from 2 in. boiler tubes to 4½ in. standard pipe.

This mill uses the stretch principle in tube production and this is one of the most important recent developments to improve the productive capacity of small diameter seamless tube mills. Tension is used in the final sizing operation on the hot mill. This operation permits sub-standard reduction in the wall thickness of the tube to be made in the sizing mill, and it also pro-

vides a means for making very large reductions in the diameter of the tube with a relatively smaller number of roll stands. The tension is developed by increasing the relative speeds of the rolls to a greater degree than that needed to compensate for the change in the cross-sectional area. Individual motor drives are used on each stand, and by means of variable voltage control, the delivery speed of the mill can be adjusted without affecting materially the relative speeds of the individual stands; yet the speed of any stand can be varied by the adjustment of the motor speed. The amount of wall reduction under a specific set of mill conditions can be varied within limits by changing the relative speed ratios of the consecutive roll stands. In this manner, finished tubes of a given diameter but of several wall thicknesses can be produced from the same entering shell sizes but with no change in mill setting except adjustments of the several drive motor speeds. With the stretch reducing process, area reduction can be varied either by changing the overall reduction in the diameter of the tube through the addition or removal of roll stands, by changing the amount of wall reduction through adjustment of roll speed ratios, or by a combination of both.

Other pipe mills in this plant are being revamped and one interesting feature is the underground conveyors which will be installed on two of the butt weld mills to handle the pipe from the hot finishing end and thus free overhead cranes for other service.

Another pipe maker is mass-producing large diameter pipe by a special forming, welding in sizing process, which production of 40 ft lengths. Pipe is welded with 1,000,000 ampere flash welders which are capable of making a 40 ft seam weld in one step. The straightening,



Assembly arrangement of traction type fluid drive and mechanical transmission, now being used in many applications.

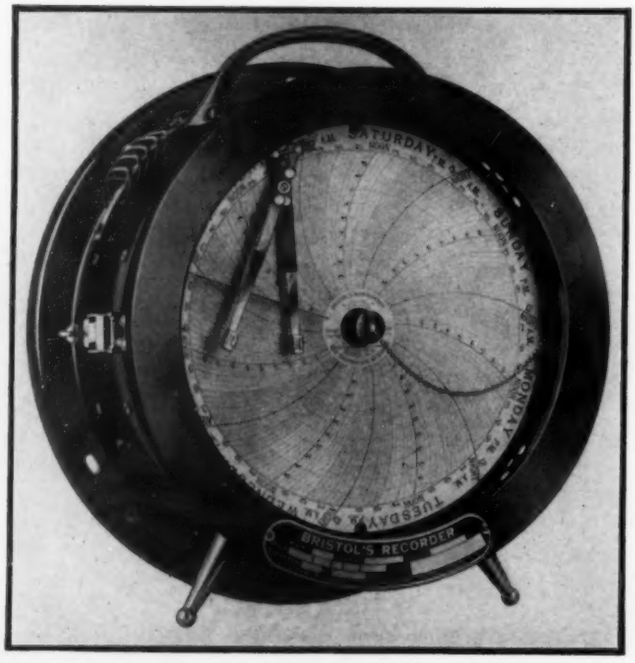
flash trimming, end rounding, internal sizing and end facing are all done on mass production basis.

In cold drawing stainless steel tubing, the use of adhesives in cold drawing has been found effective in reducing the tendency of the steel to pick up or gall between the surfaces of tube, die and mandrel under drawing pressures as high as 200,000 psi. The process uses particles which adhere to the tube metal as the drawing takes place. Adhesives used have been glue, sodium silicate, synthetic resins, varnish and other materials in conjunction with lime, chalk, mica, rouge, lithopone, etc.

Seamless tubing with highly accurate mirror-like internal surfaces, in intricate shapes, is being made by a process of electroforming iron. The process is similar to electroplating except for the greater amount of deposited metal used. The process requires special electrolytes and controls. Seamless tubes can be produced with inside diameters with tolerances of plus and minus 0.0002 in. There is no limitation to shape as long as a mandrel may be pulled away from the electroformed part.

Only recently the effect of variation in the proportional limit of the material on the collapsing strength of tube casings has been properly evaluated. Warm working has been found to provide a means for uniformly proportional limit and thus increasing the collapsing strength. This is done by charging the pipe directly to a continuous furnace from the hot sizing operation. As soon as the temperature of the pipe is equalized and brought to the required level from the furnace, the pipe passes directly through a multiple stand reducing mill and thence to the cooling table. The layout of the equipment provides for alternate lines of travel, one by-passing the work hardening process, and the other delivering the pipe from the hot sizing operation to a cooling table on which the temperature is reduced below the lower critical point. It is then charged to a continuous normalizing furnace and from that furnace to the temperature equalizing furnace and then through the reducing mill. The advantages resulting from the improved process are the extension of the range of possible combinations of the physical characteristics of the

This direct reading relative humidity recorder uses a wood parchment element whose dimensional changes move the pen. The instrument is used, for example, in moisture control of blast for the blast furnace.



hot rolling pipe diameter reduction, and temperature at which the reduction is effective.

In line with the emphasis on finished products, the steel industry is devoting much attention to its finishing facilities. Under construction or on order is approximately 1,000,000 ton of tin plate capacity. There have not been too many developments in new basic equipment but many processing operations are being made automatic.

Of the newer finishing methods, electrolytic polishing has been found particularly adaptable to polishing stainless steel, especially for small deep parts that would be hard to polish in any other way.

Modernization of electrolytic and hot dip processing lines have required many unique and new facilities. In one line, a 9600 cycle induction and resistor type heating furnace divided into a series of adjustable cooling zones is used. In another, rotating regulators have been applied on the shear of the annealing and galvanizing line as a start and stop control, and eliminating the usual gage table with its solenoids, brakes and contactors.

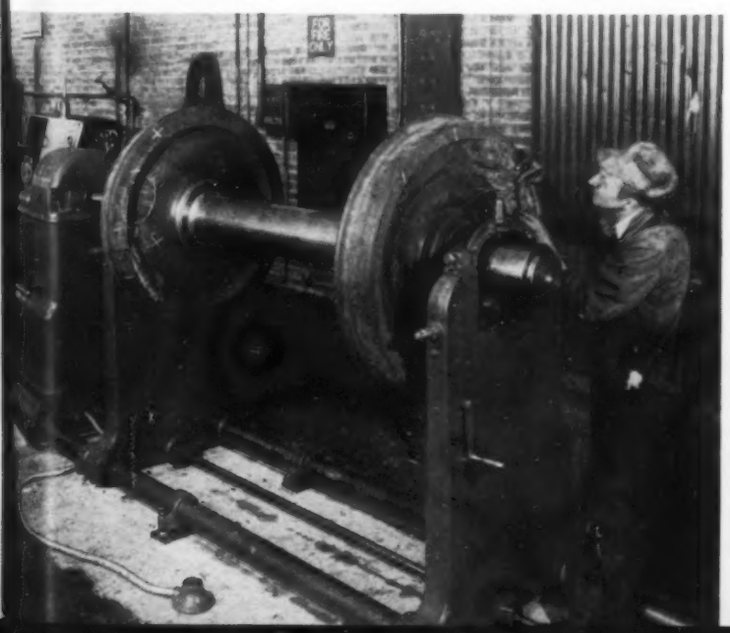
One mill is using a continuous hot dipping process to make an aluminum dip-coated steel. This coating is about as thick as a standard galvanized coating, but is, of course, less than one-half the weight of the equivalent zinc coating. The actual thickness of the aluminum film is 0.01 in. This type of coated sheet costs about twice as much as a galvanized sheet of the same thickness, but will be economical for some applications.

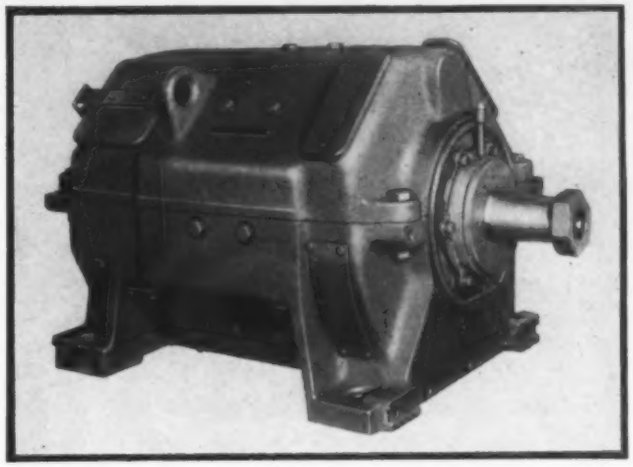
A heavy gage continuous hot dip galvanizing line is under construction in the Pittsburgh area. The line will produce heavy gage galvanized steel from 16 to 11 gage. Production will be about ten tons per hour. The new line will handle coiled material up to 54 inches wide and will be the first wide continuous galvanizing line installed by this company. The coating on the finished material will be sufficiently strong to withstand shaping or drawing without flaking or peeling.

A new mechanical pickler which automatically raises and lowers five to ten tons of bars at a pre-determined continuous rate has been found effective in accelerating pickling of steel bars in the pickle vat, the procedure causing relative movement of the bars, thus cracking the oxide scale and aiding its easier removal. The pickler can be built in any capacity.

The use of sodium hydride to remove mill and process scale has found increasing favor, because pitting does not occur. The method can be applied to all metals and alloys which do not react with fused caustic soda, and whose physical characteristics are not adversely affected by the 700 F temperature.

Machines for balancing rotating parts are finding ever increasing use in modern maintenance shops.





The MD612 motor shown is a new development which has a one hour mill rating of 75 hp, although its dimensions are that of the old 400 line 50 hp motor.

FURNACES AND CONTROLS

Few radical developments in furnace design occurred during the year. However, the fuel shortages which have been present the past few years and particularly this past year have led some plants to install combustion equipment which will burn either oil or gas, and burners have been developed which will either burn bunker C fuel oil or 500 Btu gas.

One Eastern steel plant has been able to attain a marked reduction in plant fuel cost by using combination firing of open hearths with mixed coke oven and blast furnace gases, and fuel oil. The use of the mixed fuel gave better performance (in one comparison a furnace with a mixed fuel gave 10.045 net tons per hour as against 9.92 for the regular furnace using fuel oil). The fuel cost comparison was 1.2074 dollars per net ton as against 1.2193 dollars per net ton for fuel oil, and this cost comparison is even more favorable if one considers that 2/3 of the total fuel consumed in the mixed fuel furnace are by-product fuels.

Although soaking pit practice still requires judgment on the part of the heater, a major portion of the burden of control is falling on the instruments which tell the heater what is going on within the pit. These instruments tell him the temperature which is being maintained, the exact ratio of fuel to air, the pressure in the pit itself, the atmosphere surrounding the ingots, and the rate at which fuel is being burned.

One of the mills in the Chicago district is rebuilding three of its existing slab heating furnaces, and adding two new ones in a five unit arrangement. Each furnace will have a capacity of 105 tons per hour, and have a

Despite the difference in size, these two motors each produces 10 hp at 1750 rpm. The smaller has high temperature silicone insulation and weighs 210 pounds, the larger has class A insulation and weighs 410 pounds.

heating rate in excess of 150 lb of steel per sq ft of effective hearth area per hour, a high capacity. The furnaces will heat slabs 3½ to 7½ in. thick, 18 to 76 in. wide, and 6 to 18 ft long. One feature is the use of a new design of alloy metal recuperators which will deliver preheated air at 700 F to the furnaces. Recuperators of this design, built up of two concentric metal tubes, one inside of the other, have been in use for several years in similar applications with excellent results.

Considerable progress has been made in developing continuous equipment for annealing steel. At the present time, most such developments involve light sections, although the day may not be too far off when such methods will be adopted to practically all types of products. Induction, gas, or oil heating may be used. New developments enable heating of thick sections in the matter of minutes, while thinner sections may take only a few seconds. Both gas and induction heating are used in heating billets prior to forging.

Gas fuels are used, for example, in annealing stainless steel bars and tubings, and have the advantages of uniform heat treatment, lack of distortion, and similar surface finish and cost on all units. Such rapid heating has been the result of development of burners with a much higher temperature gradient than was available previously, and the gains in "thermal head" give large gains in heat transfer rates. Furnaces usually utilize a large number of small burners, whose operation is in turn dependent on accurate carburetion and special ceramics.

Induction heating is finding many applications in mass heating, for forging, annealing, and surface heating, such as heating steel for hardening. As an example, induction heating of steel bar stock shows particular promise, because of freedom from warpage, scale cracking, and decarburized surfaces. Frequencies used are 960, 3000, and 9600 cycles with rotating machines, and 450 kilocycles with electronic apparatus. The unique feature of an assembly is the absence of terminals or electrodes in contact with the charge. In general the charge must be of conductive material.

The heating of fast moving steel strip by the inductive method to moderate temperatures such as 464 F is a simple application because of the beneficial effects of the magnetic property, and the low rate of heat loss from the strip. However, induction heating for moving steel strip to temperatures above the Curie point is a problem that has not been solved.

One furnace recently developed for the continuous heating of strip for such processes as annealing tin plate, and continuous galvanizing lines is based on the tower principle. A small furnace was built on this principle about ten years ago, but recently it has been developed to anneal ten tons of tin plate strip per hour. The strip moves at a traveling speed of 300 fpm. A furnace such as this would have an electrical rating of 1700 kw, and when heating the strip to 1350 F, and with ten tons per hour output, the power requirement is about 1300 kw or 130 kw per net ton. Such furnaces can be equipped with automatic control for both heating and cooling, so that correct entrance temperature is maintained and adjustments will thus be automatically made for variation and speed.

The increase in coil sizes led to a new furnace development for coil annealing which claims several outstanding features, such as increased uniformity of heating application, more tons per hour and a reasonable processing time for large diameter coils. Furnaces have already been built for the following charge sizes: 48 in. diam, 96 in. piling height; 60 in. diam, 126 in. piling height; and 78 in. diam, 140 in. piling height. The critical point in the design of the furnace is a compensating convector which provides heat to the coil edges at such rates as will insure acceptable temperature fields in the coils. To do this, it must compensate for the radial heat supplied the outer wrap and must compensate for the temperature change in the recirculated gas as it passes through the convector. These compensations are effected by the vane shapes which reduce the area of passage and increase the mass velocity of the gas as it flows through the oil core, and at the same time increase the convection transfer service.

The rotary hearth furnace has been widely installed during the past few years for industrial heating or heat treating. This furnace enables one to more easily allow for changes in analysis, shape and size of steels by the simple procedure of leaving a space between two adjacent groups of billets. In addition, due to the fact that the steel remains in one position in the rotary furnace, only a single scale jacket is formed which gives savings as high as 2 per cent above the roll down furnaces. The rotary furnace has several disadvantages, one of which is presenting a hot hearth to the steels that are being charged on it. Some qualities of alloy steels cannot stand the thermal shock and it would not be economical to cool the hearth both at discharge and charging doors.

A number of furnace details have been improved in the past year. A new water cooled door has been developed for open hearth and heating furnaces which sponsors claim has increased the life of the linings to 150-200 heats. Water cooled ribs divide the refractory into easily cooled sections which not only strengthen the door but also eliminate warpage.

One unique innovation in charging some box furnaces has been the adaption of an ordinary industrial lift

truck for pushing large and heavy carburizing boxes into the chambers of box furnaces. The truck requires relatively small alterations to adapt itself to this work.

A new type of burner has been installed in several open hearth furnaces in Russia. This new burner has the ability to operate at the usual air or steam pressure of four to five atmospheres. It has a high degree of flame stability, effective flame length control, wide load range control, and attains a very high degree of oil atomization. The burner gives satisfactory service in spite of fluctuation in the air supply pressure of 2 to 6 atmospheres, and changes in the oil pressure of 3 to 5½ atmospheres. Its use reduced the time for meltdown from 40 to 48 minutes, and the time of working the heat was shortened 16 to 39 minutes.

Control of furnace temperature can be only as accurate as the means for measuring the temperatures. Consequently, the pyrometers which have been recently developed are a further step in improvements of furnace operation. Two methods which give promise are the quick-immersion platinum thermocouple, and the open-end tube immersion pyrometer, and these two pyrometers are designed to meet the requirements of practicability as well as accuracy and reliability in the steel mill. They will undoubtedly find increasing use in the open hearth and electric furnace shops, as more exacting requirements are placed upon steelmakers.

MATERIALS HANDLING

Much materials handling equipment has been installed in the past year. For example, several steel mills have installed conveyors to handle coils of steel strip. Although, conveyors are not new, the latest installations have some unique features. In one mill, the feeder conveyor is 50 ft long but designed for future extension to 200 ft. A new application of the booster drive provides the driving power which makes future extension possible. Coils are weighed on the conveyor. The use of the system eliminates edge damage and telescoping, and a steady supply of coils to the pickler is assured. The demand on crane service is lessened, and there is no lost time because of interference between overhead cranes. At another plant the use of a conveyor allows several cranes to unload coils from the line, at several points at the same time, without interference.

The increasing trend in the use of industrial floor trucks still continues, and a recent survey shows that slightly over one-half of the trucks were gasoline engine powered with the remainder being battery powered.

Radio cummunication for railroad and switchyard operation developed during the year as a result of the assignment in 1945, by the Federal Communications Commission, of the 158 to 162 megacycle frequency bands to railroad use. This has permitted concentration by the radio manufacturers on the development of installation of railroad communication equipment in the approved bands. Radio sets are available which can be used in either the locomotive or the caboose, and their use has been found to expedite yard switching.

One ingenious device which was recently developed for handling materials in railroad cars is called a car shaker. A vibrator powered by an electric motor shakes the car, and the material in the car then runs out the hopper. The device is of particular value in cold and freezing weather.

Another method which has been developed for unloading frozen coal in hopper cars involves the principle of radiant heat. Thawing pits are built between the track rails, and so spaced that they are located under the hoppers. Pits are heated by burners using either oil or gas. There is no flame in contact with the hopper area. It is said that not more than half an hour is necessary to dump a load under the worst of freeze-ups, and, in normal winter weather, only 15 minutes are needed after the burners are ignited. Fuel consumption varies with the weather and size of the car but usually runs less than one dollar per car.

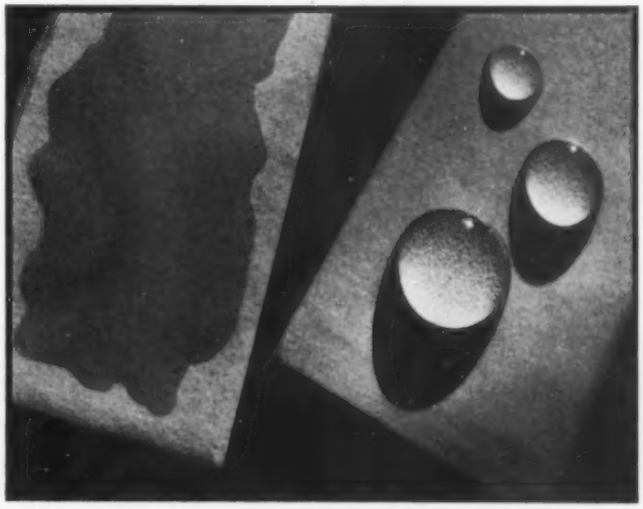
Cleveland's lake front ore handling facilities are being greatly improved with the installation by the Erie Railroad of a new 17 ton Hulett unloading machine. This machine replaces four electric machines of smaller capacity installed about forty years ago.

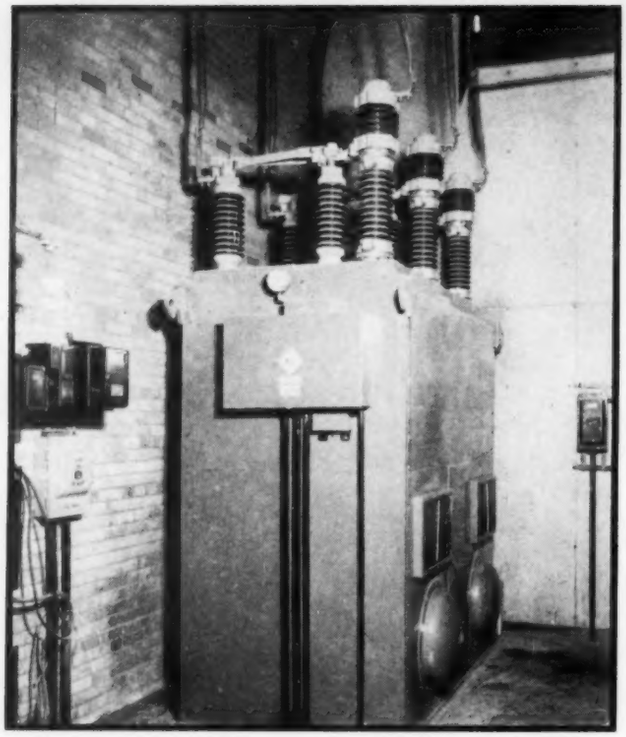
MECHANICAL DEVELOPMENTS

Some of the most important developments in the mechanical field are those in the field of instrumentation and inspection devices. Equipment which at one time — and this only a short time ago — was essentially laboratory equipment, is now being installed and used in regular production operations. Some of this equipment made possible the speedier operations necessary with the less highly trained personnel which have been available during the past few years.

The mass spectrometer is a machine used to separate molecules by virtue of differences in their momenta. Four steps are involved in making a mass spectrometric analysis, and at the present time the analysis can be made of gases only. The first step is to give a positive charge to the molecules that are to be separated; the second step is to give all positive ions the same energy;

The silicone compound used on the porcelain insulating plate on the right has repelled the water. The uncoated plate on the left has been made useless by the same moisture.





Typical installation of 23 kv, 600 amp carrying capacity, 1500 amp maximum interrupting capacity, air blast arc furnace interrupter switch.

the third step is to separate various ions by a magnetic field placed at right angles to the direction of motion of the ions; and in the fourth step which is the last, all of the molecules having a given radius of deflection are collected and recorded. A picture of the galvanometer recordings is made on a photographic plate which gives the picture of the relative abundance of each molecular species present. The result is an analysis of the gas. The advantages of the method are that accurate analyses of the composition of complex hydrogen carbon mixtures can be made in a few hours, and the quantity of the sample required is very small. The handicaps to the method at the present time are the high cost of the apparatus, and the highly trained men needed to operate it. Also, the present instruments can not be used directly in the analysis of solids, but there is good reason to believe that positive ion gun and arc sources will soon be provided so that solids such as alloys can be analyzed with a high degree of precision. The mass spectrometer should not be confused with the optical spectrometer, since the latter instrument measures the spectrum of a gas formed by diffraction or by a prism. The mass spectrometer measures the currents carried by the ions of each mass, and this is done through amplification tubes which amplify the current a billion times. The current in turn is fed into galvanometers whose deflections are recorded on sensitive photographic paper.

Another use for the mass spectrometer has been the development of a leak detector to inspect leakage from valves or tanks. A gas such as helium is placed in the item to be checked and the detector analyzes the gas on the outside of the item for the presence of helium.

One of the newest developments in inspecting materials for the presence of flaws uses supersonic waves. The supersonic analyzer consists of a piezo-electric crystal receiver and a signaling or marking device. In operation, the transmitter sends supersonic waves through the material being examined, and these waves are reflected back and picked up by the receiver. A constant result is registered until flaws, or discontinuities, are encountered, and this is noted on the marking device. The analyzer can locate flaws as small as one-thousandth of an inch in thickness. In general, the surface point at the transmitter must be relatively smooth over the contact area and the reflecting surface must also be relatively smooth. Otherwise older methods such as the X-ray must be used. Frequencies of 1 to 5 megacycles are most suitable for the supersonic inspection of steel billets.

Another interesting method for inspection is called the magnetic analysis inspection method, and this should not be confused with magnaflux inspection. The method at present is limited to the inspection of certain types of material such as steel bars and tubes as well as cast or machined steel parts of irregular or similar shape. The method is based on the principle that the magnetic properties of a specimen vary with the changes in physical, chemical, mechanical and metallurgical characteristics, and second that the variation of the magnetic properties can be visualized by suitable electric or electronic devices. Defects in the material to be inspected affect the magnetic properties.

Work has been resumed on the X-ray thickness gage for strip and sheets, and field tests are now being made on such a unit. This will be used in a regular installation if the field test proves it advisable.

Several devices in the field of crane mechanisms have been recently developed. One device consists of a 60 ton slab turnover mechanism which is used in connection with a 206 in. plate mill. This large mill requires ingots as large as 90,000 lb. The mechanism consists of a framework which is very similar to that of a crane trolley, on each corner of which is a rack driven by a pinion. The turnover mechanism consists of a main shaft, driven by a 65 hp motor, and on this shaft are located three elongated castings or drums to which are fastened three long slings. The two ends of the sling are fastened to the same point on the drum. In the operation, the hoist is lowered so that one set of castings (which forms a part of the sling) is in position between the table rolls. The frame is raised by means of the rack and pinions to a height sufficient to permit turning the slab. The drums are then rotated, thus turning the slab, and the framework is then lowered thus setting the ingot back on table rollers.

Another interesting device at this mill is a telescopic stiff-leg soaking pit crane. This crane can be used in locations where limited head room and light runways do not permit the use of the conventional stiff-leg cranes. Prior to the installation of the crane, ingots had to be charged with the use of standard mill cranes and tongs. The new design is based on the use of hollow, rectangular, telescopic, revolving, self-lubricating, flexibly connected and stiff-leg.

A useful application in steel mill maintenance during recent years has been the use of chemical removal of scales, sludges and oxides from blast furnace cooling systems, and from the steel mill units which use cooling waters such as the power plants. In the case of the blast furnace, the unit can be cleaned without removing the

furnace from production. One of the factors in the use of the method has been the development of inhibitors for protecting the various metals of the vessel at elevated solvent temperatures.

There is an increasing trend to use high pressure steam for steel mill power; by high pressure is meant 500 psi or more. At the present time there are about six such plants operating in steel mills in the United States. The operating economies of high pressure plants is naturally dependent on specific study of a particular plant and its load factors. However, in one example, a 400 psi gage, 750 F throttle pressure and temperature, steam, electric generating plant might have a heat rate of approximately 13225 Btu kwhr. By increasing the pressure and temperature to 800 psi gage, 900 F, the heating rate would be reduced to about 11,875 Btu per kwhr. Further increase in pressure will further reduce heat requirements.

In the preparation of materials for fabrication, developments in shot blasting have shown that with certain types of grit, the method is the equivalent of shot peening and appears to better the surface properties of some metals.

Much has been written about the development of silicones. Silicone greases have been developed which are designed for the lubrication of ball bearings operating at abnormally high and low temperatures. These greases are characterized by a high order of heat stability, low volatility, relatively low changes in consistency over a wide temperature range, and low freezing points. It is claimed that these greases can be used at temperatures up to 500 F, although it may be necessary to use bearings with larger clearances to compensate for temperature differentials.

As the pressure for better working conditions in the mills by the unions continues, greater emphasis is being placed on mill building ventilation. At one steel company's plant, a successful method of conditioning was installed by using the excess high pressure steam that was easily available to provide make-up air at the proper temperature for the air which was vented. Large fan and heating coil units were installed at the quarter points of the mill building, with each fan running at 125,000 cfm. Heating coils were designed to utilize the steam which was at 250 psi, and 500 F. The warm ventilation air was run through ducts and distributed at a point about four feet above the floor level. The installation has been so successful that the mill is contemplating the addition of two more.

One factor which will be of increasing concern in the steel plant is the efforts of public authorities to decrease stream pollution, which efforts in turn may force many mills to change their waste water disposition. Several states are placing increased emphasis on this program, and Pennsylvania has probably set the pace. Methods to be used will, of course, vary with the plant and the type of effluent.

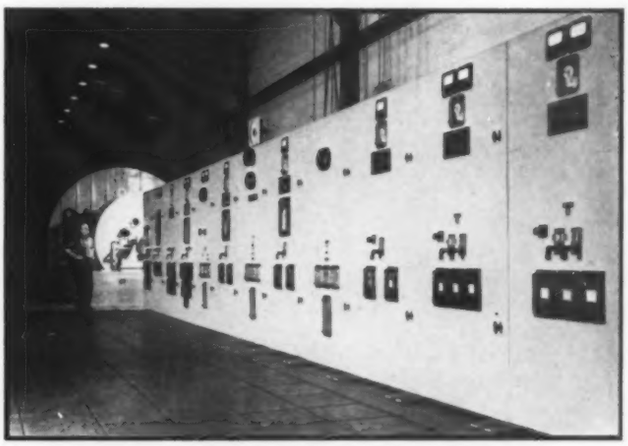
ELECTRICAL DEVELOPMENTS

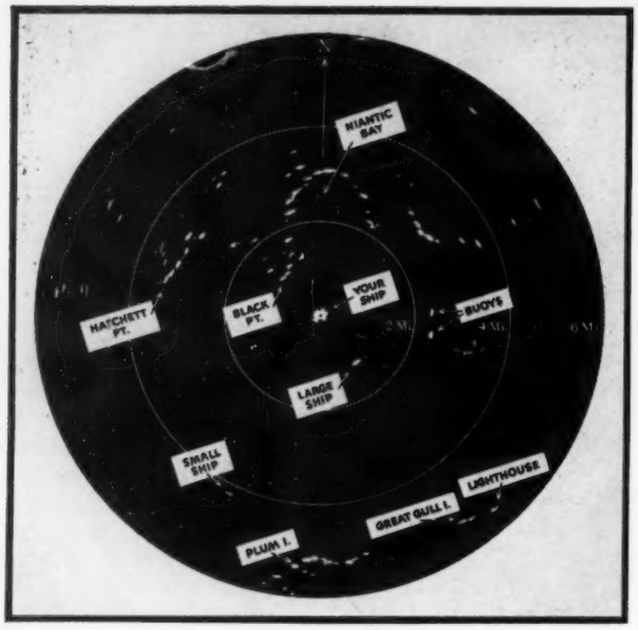
One of the continuing major developments in the electrical field of the steel industry has been directed to the more exacting automatic control which was necessary for a speed-up in various production operations, operations which could not have been developed to their present state if it were necessary to rely upon manual control. With the better automatic control, one of the trends in electric installations has been that, for example, of installing individual generators in rolling mill equipment. The development of suitable control has enabled the synchronization of such units. Rotating regulators are used for the many applications such as, for example, that of synchronizing the speed lever rolls and master pinch rolls in the new combination, annealing and pickling lines for stainless steel.

One of the most important electric developments of the year to the steel mill has been the introduction of a new line of mill motors. This motor has the next larger electrical ratings of a given frame, and maintains the old external mounting dimensions. Thus the rating of an AISE No. 10 motor are put into a frame whose mounting and clearance dimensions are the same as the existing AISE No. 8 frame.

Another improvement in motor design is a new line of induction motors which was announced by one of the manufacturers. This new motor reduces the frame size for comparative ratings. Starting torques have been increased per lb of motor and high efficiencies and power factors are maintained. The new motor takes advantage of some of the new features in insulation materials and improved winding techniques. One interesting feature is the use of steel instead of the more conventional cast iron for the frame. This use makes the motor stronger and the unusual feature in the use of the steel is that the same thicknesses are maintained as would be present if cast iron were used. The manufacturer claims increased shock resistance and also that the frame will last as long as a cast iron frame. He states that it is a fallacy that steel corrodes faster than cast iron, if the same thickness of steel is used. Seal

New blooming mill motor room at the Alan Wood Steel Company, Conshohocken, Pennsylvania. As part of a general modernization project at the Ivy Rock Plant, a 10,000 kva substation for 60 cycle purchased power was installed to supplement the plant's 25 cycle power system. 60 cycle power is distributed at 6600 volts through the metal clad, air break switchgear in the foreground. Circuits are provided to the blooming mill flywheel set in the background, to two new plate mill motors, to 250 volt rectifiers, and miscellaneous light and auxiliary power circuits.





The view of the radar screen in the ore boat shown gives valuable navigational help, and thus expedites ore shipments.

bearings which will not require lubrication for at least five years are used in the motors.

A great deal of development is taking place in adding additional life to motor brushes. War research indicated that brush wear was a factor of the moisture in the air. For minimum brush wear, a water vapor pressure of three mm of mercury is about right, and for maximum wear, the per cent relative humidity should go down as the temperature increases.

Silicone varnishes and resins found increased applications. A silicone varnished glass cloth has shown an ability to withstand 24 hours at 250 C without losing any flexibility. Test data also shows that the varnish rather closely follows the "ten degree rule," and that in the range from 200 C the life of the resin doubles for each 10 C drop in temperature. The use of such insulations in motors eliminates several of the factors which restrict the ratings to the present values.

One of the several advances in new equipment has been the development of copper oxide rectifiers. They have the advantage of flexibility in location, and ability to operate economically at less than peak loads and thus assure continued use for charging batteries of material handling trucks.

Numerous applications will be made of fractional hp slow speed motors of the synchronous, inductor type, having a relatively high torque, instantaneous starting, and quick stop upon interruption of current. Possible applications and uses are in the operation of counters, synchronizers, and step rheostats.

Another trend which has continued has been the effort to design mill drives so that they have the lowest inertia or WR^2. This development has, of course, led to the use of a large number of individual motors, whenever possible, instead of one motor such as twin drives and double armature motors.

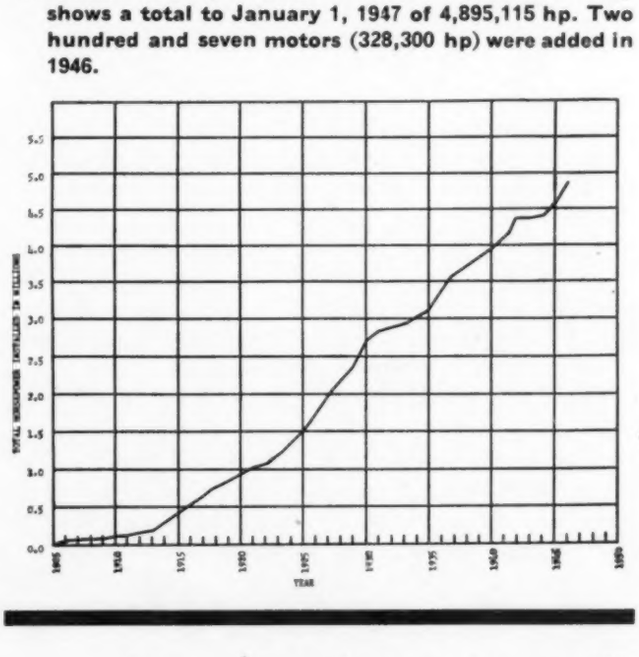
An entirely new liquid slip regulator for starting and speed control of wound rotor motors has been recently announced. The principle on which the regulator works combines a variable electrolyte level with movable electrodes. A rotating regulator control varies the position of the movable electrode when required to maintain constant load or speed on the motor.

Developments in the modern arc furnace have been concentrated in the design of the air blast type power circuit breakers and in rotating regulator controls which regulate the position of the electrode. The new type circuit breakers have been designed on the assumption that they are used for switching purposes rather than overload purposes, and as such have been developed for a much longer life.

A new line of oil circuit breakers was recently demonstrated on breakers with 100 mva and 150 mva interrupting capacity which employ a new "exotherm," principle of arc extinction. As the temperature of a gas is increased, its conductivity is increased, although not in a linear fashion, and as the pressure of a gas is increased, its conductivity decreases. Any arrangement whereby the heat of an arc can be extracted tends to make the arc medium non-conducting, and thereby quenches the arc. The new circuit breakers accomplish this in an oil circuit breaker, by bringing the arc in intimate contact with the oil, and taking out a maximum amount of heat, thus raising the dialectric strength to a point where the arc is quenched as the current passes through zero. At the same time, the high pressure in the quencher assists the process.

One electrical development taken directly from Navy operations has been the application of radar to ore boats on the Great Lakes. Thus operations are possible in weather which would never have allowed operation before.

The cumulative curve of main drive motors over 300 hp shows a total to January 1, 1947 of 4,895,115 hp. Two hundred and seven motors (328,300 hp) were added in 1946.



ELECTRIC MOTORS OVER THREE HUNDRED HORSEPOWER

APPLIED TO MAIN ROLL DRIVES IN THE IRON AND STEEL AND ALLIED INDUSTRIES DURING 1946

Item	Horse-power	Revolutions per minute	Volts	Frequency	Method of drive	Kind of mill	Purchaser	Location	Manufacturer
1	300	150/750	600	d-c	Direct	Cold strip reel	Acme Steel Company	Riverdale, Illinois	Westinghouse
2	300	400/1000	250	d-c	Geared	Aluminum cold sheet mill	Aluminum Company of South Africa	South Africa	Westinghouse
3	300	300/750	600	d-c	Geared	Rod mill	Laclede Steel Company	Alton, Illinois	Westinghouse
4	300	300/550	600	d-c	Direct	Rod mill	Laclede Steel Company	Alton, Illinois	Westinghouse
5	300	500/1450	250	d-c	Geared	Cold strip reel	Kaiser Company	Fontana, California	Westinghouse
6	300	500/1450	250	d-c	Geared	Cold strip reel	Kaiser Company	Fontana, California	Westinghouse
7	300	900/250	600	d-c	Geared	Rod and merchant mill	Bethlehem Pacific Coast Steel Corporation	Vernon, California	Crocker-Wheeler
8	300	900/250	600	d-c	Geared	Rod and merchant mill	Bethlehem Pacific Coast Steel Corporation	Vernon, California	Crocker-Wheeler
9	300	900/250	600	d-c	Geared	Rod and merchant mill	Bethlehem Pacific Coast Steel Corporation	Vernon, California	Crocker-Wheeler
10	300	300/1000	600	d-c	Geared	32 in. Temper pass mill	Bethlehem Steel Company	Sparrows Point, Maryland	Allis-Chalmers
11	300	300/1380	600	d-c	Geared	32 in. Temper pass mill reel	Bethlehem Steel Company	Sparrows Point, Maryland	Allis-Chalmers
12	300	225/900	600	d-c	Geared	60 in. Temper pass mill reel	Columbia Steel Company	Pittsburg, California	Allis-Chalmers
13	350	625/225	600	d-c	Direct	Rod and merchant mill	Bethlehem Pacific Coast Steel Corporation	Vernon, California	Crocker-Wheeler
14	350	625/225	600	d-c	Direct	Rod and merchant mill	Bethlehem Pacific Coast Steel Corporation	Vernon, California	Crocker-Wheeler
15	350	275/550	250	d-c	Geared	Reversing hot aluminum mill	Aluminum Company of South Africa	South Africa	Westinghouse
16	350	375/750	230	d-c	Direct	Seamless tube mill	U. S. S. R.	U. S. S. R.	General Electric
17	350	375/750	230	d-c	Direct	Seamless tube mill	U. S. S. R.	U. S. S. R.	General Electric
18	350	350/950	600	d-c	Geared	42 in. Temper pass mill, upper delivery tension	Columbia Steel Company	Pittsburg, California	Allis-Chalmers
19	350	350/950	600	d-c	Geared	42 in. Temper pass mill upper delivery tension	Columbia Steel Company	Pittsburg, California	Allis-Chalmers
20	400	350/700	600	d-c	Geared	Rod mill	Crucible Steel Company of America	Midland, Pennsylvania	General Electric
21	400	350/800	600	d-c	Direct	Rod mill	Crucible Steel Company of America	Midland, Pennsylvania	General Electric
22	400	500/1000	250	d-c	Geared	4-High, 2-stand tandem mill	Revere Copper and Brass Company	Detroit, Michigan	General Electric
23	400①②	575/750	300	d-c	Direct	2-Stand temper pass mill	Bethlehem Steel Company	Sparrows Point, Maryland	General Electric
24	400①②	575/750	300	d-c	Direct	2-Stand temper pass mill	Bethlehem Steel Company	Sparrows Point, Maryland	General Electric
25	400①②	575/750	300	d-c	Direct	2-Stand temper pass mill	Bethlehem Steel Company	Sparrows Point, Maryland	General Electric
26	400①②	575/750	300	d-c	Direct	2-Stand temper pass mill	Bethlehem Steel Company	Sparrows Point, Maryland	General Electric
27	400①③	575/750	300	d-c	Direct	2-Stand temper pass mill	Bethlehem Steel Company	Sparrows Point, Maryland	General Electric
28	400①③	575/750	300	d-c	Direct	2-Stand temper pass mill	Bethlehem Steel Company	Sparrows Point, Maryland	General Electric
29	400①②	575/750	300	d-c	Direct	2-Stand temper pass mill	Bethlehem Steel Company	Sparrows Point, Maryland	General Electric
30	400①②	575/750	300	d-c	Direct	2-Stand temper pass mill	Bethlehem Steel Company	Sparrows Point, Maryland	General Electric
31	400①②	575/750	300	d-c	Direct	2-Stand temper pass mill	Bethlehem Steel Company	Sparrows Point, Maryland	General Electric
32	400①③	575/750	300	d-c	Direct	2-Stand temper pass mill	Bethlehem Steel Company	Sparrows Point, Maryland	General Electric
33	400①③	575/750	300	d-c	Direct	2-Stand temper pass mill	Bethlehem Steel Company	Sparrows Point, Maryland	General Electric
34	400①③	575/750	300	d-c	Direct	2-Stand temper pass mill	Bethlehem Steel Company	Sparrows Point, Maryland	General Electric
35	400	300/900	600	d-c	Geared	Reversing brass strip mill	Laminacao Nationale	Brazil	Westinghouse
36	400	300/900	600	d-c	Geared	Reversing brass strip mill	Laminacao Nationale	Brazil	Westinghouse
37	500	900/300	600	d-c	Geared	Rod and merchant mill	Bethlehem Pacific Coast Steel Corporation	Vernon, California	Crocker-Wheeler
38	500	900/300	600	d-c	Geared	Rod and merchant mill	Bethlehem Pacific Coast Steel Corporation	Vernon, California	Crocker-Wheeler
39	500	350/700	250	d-c	Geared	Sendzimir brass strip mill	American Brass Company	Buffalo, New York	Westinghouse
40	500	500/1000	600	d-c	Geared	Skin pass cold strip mill	Bethlehem Steel Company	Lackawanna, New York	Westinghouse
41	500	350/525	525	d-c	Geared	Reversing edging mill	Aluminum Company of America	Davenport, Iowa	Westinghouse
42	500	350/525	525	d-c	Geared	Reversing edging mill	Aluminum Company of America	Davenport, Iowa	Westinghouse
43	500	300/900	600	d-c	Geared	Rod mill	Laclede Steel Company	Alton, Illinois	Westinghouse
44	500	575/1150	600	d-c	Geared	Brass strip mill	Winchester Repeating Arms Company	New Haven, Connecticut	Westinghouse
45	500	250/500	600	d-c	Direct	Rod mill	Crucible Steel Company of America	Midland, Pennsylvania	General Electric
46	500	300/900	600	d-c	Geared	Rod and merchant mill	Sheffield Steel Corporation	Kansas City, Missouri	General Electric
47	500	300/900	600	d-c	Geared	Rod and merchant mill	Sheffield Steel Corporation	Kansas City, Missouri	General Electric
48	500	300/900	600	d-c	Geared	Rod and merchant mill	Sheffield Steel Corporation	Kansas City, Missouri	General Electric
49	500	300/900	600	d-c	Geared	Rod and merchant mill	Sheffield Steel Corporation	Kansas City, Missouri	General Electric
50	500	300/900	600	d-c	Geared	Rod and merchant mill	Sheffield Steel Corporation	Kansas City, Missouri	General Electric
51	500	300/700	600	d-c	Direct	Rod and merchant mill	Sheffield Steel Corporation	Kansas City, Missouri	General Electric
52	500	300/700	600	d-c	Direct	Rod and merchant mill	Sheffield Steel Corporation	Kansas City, Missouri	General Electric
53	500	300/700	600	d-c	Direct	Rod and merchant mill	Sheffield Steel Corporation	Kansas City, Missouri	General Electric
54	500	300/700	600	d-c	Direct	Rod and merchant mill	Sheffield Steel Corporation	Kansas City, Missouri	General Electric
55	500	250/875	600	d-c	Geared	29 in. Reversing cold mill	Sharon Steel Corporation	Sharon, Pennsylvania	General Electric
56	500	250/875	600	d-c	Geared	29 in. Reversing cold mill	Sharon Steel Corporation	Sharon, Pennsylvania	General Electric
57	500	600/1200	600	d-c	Geared	Single stand mill	Chase Brass and Copper Company	Cleveland, Ohio	General Electric
58	500	600/1200	600	d-c	Geared	Single stand mill	Chase Brass and Copper Company	Cleveland, Ohio	General Electric
59	500	300/1050	600	d-c	Geared	Cold mill reel	U. S. S. R	Zaporojstal	General Electric
60	500	300/750	750	d-c	Geared	9-Stand reducing mill	National Tube Company	Lorain, Ohio	General Electric
61	500	300/750	750	d-c	Geared	9-Stand reducing mill	National Tube Company	Lorain, Ohio	General Electric
62	500	300/750	750	d-c	Geared	9-Stand reducing mill	National Tube Company	Lorain, Ohio	General Electric
63	500	300/750	750	d-c	Geared	9-Stand reducing mill	National Tube Company	Lorain, Ohio	General Electric
64	500	300/750	750	d-c	Geared	9-Strand reducing mill	National Tube Company	Lorain, Ohio	General Electric
65	500	350/700	600	d-c	Geared	8-Stand reducing mill	National Tube Company	Gary, Indiana	General Electric
66	500	350/700	600	d-c	Geared	8-Strand reducing mill	National Tube Company	Gary, Indiana	General Electric
67	500	514	6600	60†	Geared	Sizing mill	National Tube Company	Gary, Indiana	General Electric
68	500	150/600	600	d-c	Geared	68 in. Hot strip mill finishing scale breaker	Bethlehem Steel Company	Sparrows Point, Maryland	Allis-Chalmers
69	500	300/700	600	d-c	Direct	42 in. Temper pass mill	Columbia Steel Company	Pittsburg, California	Allis-Chalmers
70	500	300/700	600	d-c	Direct	42 in. Temper pass mill	Columbia Steel Company	Pittsburg, California	Allis-Chalmers
71	600	375/750	230	d-c	Geared	Brass piercing mill	Chase Brass and Copper Company	Cleveland, Ohio	General Electric
72	600	375/750	600	d-c	Direct	20 in. Reversing cold mill	Thompson Wire Company	Franklin Park, Illinois	General Electric
73	600	400/800	250	d-c	Geared	Cold mill	Reynolds Metals Company	Louisville, Kentucky	Westinghouse
74	600	125/300	600	d-c	Direct	Rod mill	Laclede Steel Company	Alton, Illinois	Westinghouse
75	600	250/750	750	d-c	Geared	Reversing cold strip reel	Republic Steel Corporation	Massillon, Ohio	Westinghouse
76	600	250/750	750	d-c	Geared	Reversing cold strip reel	Republic Steel Corporation	Massillon, Ohio	Westinghouse
77	600	250/750	750	d-c	Geared	Reversing cold strip reel	Republic Steel Corporation	Massillon, Ohio	Westinghouse
78	600	250/750	750	d-c	Geared	Reversing cold strip reel	Republic Steel Corporation	Massillon, Ohio	Westinghouse
79	600	880	440	60	Geared	Bar mill	Latrobe Electric Steel Company	Latrobe, Pennsylvania	Westinghouse
80	700②	200/940	600	d-c	Direct	Tandem cold strip mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	Westinghouse
81	700②	200/940	600	d-c	Direct	Tandem cold strip mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	Westinghouse
82	800②	150/600	500	d-c	Direct	Tandem cold strip mill	Tennessee Coal, Iron and Railroad Company	Fairfield, Alabama	Westinghouse
83	800	514	400	60*	Geared	68 in. Hot strip mill roughing scale breaker	Bethlehem Steel Company	Sparrows Point, Maryland	Allis-Chalmers
84	800	200/400	600	d-c	Direct	72 in. Temper pass mill	Inland Steel Company	Indiana Harbor, Indiana	Allis-Chalmers
85	800	125/350	600	d-c	Direct	72 in. Temper pass mill reel	Inland Steel Company	Indiana Harbor, Indiana	Allis-Chalmers
86	800	200/400	600	d-c	Direct	72 in. Temper pass mill	Inland Steel Company	Indiana Harbor, Indiana	Allis-Chalmers
87	800	125/350	600	d-c	Direct	72 in. Temper pass mill reel	Inland Steel Company	Indiana Harbor, Indiana	Allis-Chalmers
88	800	200/400	600	d-c	Direct	54 in. Temper pass mill	Inland Steel Company	Indiana Harbor, Indiana	Allis-Chalmers
89	800	125/350	600	d-c	Direct	54 in. Temper pass mill reel	Inland Steel Company	Indiana Harbor, Indiana	Allis-Chalmers
90	800	350/700	600	d-c	Direct	42 in. Temper pass mill	Columbia Steel Company	Pittsburg, California	Allis-Chalmers
91	800	350/700	600	d-c	Direct	42 in. Temper pass mill	Columbia Steel Company	Pittsburg, California	Allis-Chalmers
92	800	300/900	600	d-c	Geared	Rod and merchant mill	Sheffield Steel Corporation	Kansas City, Missouri	General Electric
93	800②	250/1200	600	d-c	Direct	5-Stand tandem cold strip mill	Inland Steel Company	Indiana Harbor, Indiana	General Electric
94	800	250/760	600	d-c	Geared	3-Stand tandem mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	General Electric
95	900	225/675	600	d-c	Geared	Tandem cold strip mill	American Rolling Mill Company	Butler, Pennsylvania	Westinghouse

ELECTRIC MOTORS OVER THREE HUNDRED HORSEPOWER-(Continued)

Item	Horse-power	Revolutions per minute	Volts	Frequency	Method of drive	Kind of mill	Purchaser	Location	Manufacturer
96	1000	400/800	600	d-c	Geared	48 in. Non-reversing cold strip mill	Aluminum Company of America	Davenport, Iowa	General Electric
97	1000	300	6000	50*	Geared	Seamless tube mill	U. S. S. R.	U. S. S. R.	General Electric
98	1000②	150/600	750	d-c	Direct	54 in. 4-Stand tandem mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	General Electric
99	1000	250/875	600	d-c	Geared	Reel	Esperance-Longdoz	Belgium	General Electric
100	1000	250/875	600	d-c	Geared	Reel	Esperance-Longdoz	Belgium	General Electric
101	1000	250/875	600	d-c	Geared	Reel	Esperance-Longdoz	Belgium	General Electric
102	1000	250/875	600	d-c	Geared	Reel	Esperance-Longdoz	Belgium	General Electric
103	1000	350/700	600	d-c	Geared	8-Stand reducing mill	National Tube Company	Lorain, Ohio	General Electric
104	1000	350/700	600	d-c	Geared	8-Stand reducing mill	National Tube Company	Lorain, Ohio	General Electric
105	1000	350/700	600	d-c	Geared	8-Stand reducing mill	National Tube Company	Lorain, Ohio	General Electric
106	1000	350/700	600	d-c	Geared	8-Stand reducing mill	National Tube Company	Lorain, Ohio	General Electric
107	1000	400/800	600	d-c	Geared	Tandem cold strip mill	American Rolling Mill Company	Butler, Pennsylvania	Westinghouse
108	1000	400/800	600	d-c	Geared	Tandem cold strip mill	American Rolling Mill Company	Butler, Pennsylvania	Westinghouse
109	1000	400/800	600	d-c	Geared	Tandem cold strip mill	American Rolling Mill Company	Butler, Pennsylvania	Westinghouse
110	1000	400/800	600	d-c	Geared	Tandem cold strip mill	American Rolling Mill Company	Butler, Pennsylvania	Westinghouse
111	1000	400/960	600	d-c	Geared	24 in. Reversing cold strip mill	Kaiser Company	Fontana, California	Westinghouse
112	1000	400/800	600	d-c	Geared	Reversing cold brass strip mill	Laminacao Nationale	Brazil	Westinghouse
113	1000	300/600	600	d-c	Geared	60 in. Temper pass mill	Columbia Steel Company	Pittsburg, California	Allis-Chalmers
114	1250	400/800	600	d-c	Geared	72 in. Cold mill	Aluminum Company of America	Alcoa, Tennessee	Allis-Chalmers
115	1250	400/800	600	d-c	Geared	20 x 36 in. Continuous billet mill	National Tube Company	Lorain, Ohio	Allis-Chalmers
116	1250	400/800	600	d-c	Geared	20 x 36 in. Continuous billet mill	National Tube Company	Lorain, Ohio	Allis-Chalmers
117	1250	400/800	600	d-c	Geared	20 x 36 in. Continuous billet mill	National Tube Company	Lorain, Ohio	Allis-Chalmers
118	1250	400/800	600	d-c	Geared	20 x 36 in. Continuous billet mill	National Tube Company	Lorain, Ohio	Allis-Chalmers
119	1250	90/270	600	d-c	Direct	Tandem cold strip mill	Acme Steel Company	Riverdale, Illinois	Westinghouse
120	1250	125/375	600	d-c	Direct	Tandem cold strip mill	Acme Steel Company	Riverdale, Illinois	Westinghouse
121	1250	200/500	600	d-c	Direct	Tandem cold strip mill	Acme Steel Company	Riverdale, Illinois	Westinghouse
122	1250	300/670	600	d-c	Direct	Tandem cold strip mill	Acme Steel Company	Riverdale, Illinois	Westinghouse
123	1250	400/800	600	d-c	Direct	Tandem cold strip mill	Acme Steel Company	Riverdale, Illinois	Westinghouse
124	1250	70/210	600	d-c	Direct	42 in. Tandem cold strip mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	Westinghouse
125	1250	70/210	600	d-c	Direct	42 in. Tandem cold strip mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	Westinghouse
126	1250	500/910	600	d-c	Geared	Rod mill	Crucible Steel Company of America	Midland, Pennsylvania	General Electric
127	1250	400/800	600	d-c	Geared	60 in. Non-reversing cold strip mill	Aluminum Company of America	Davenport, Iowa	General Electric
128	1250	750/450	600	d-c	Geared	Rod and merchant mill	Bethlehem Pacific Coast Steel Corporation	Vernon, California	Crocker-Wheeler
129	1250	450/150	600	d-c	Geared	Rod and merchant mill	Bethlehem Pacific Coast Steel Corporation	Vernon, California	Crocker-Wheeler
130	1500	250/500	600	d-c	Direct	29 in. Reversing cold mill	Sharon Steel Corporation	Sharon, Pennsylvania	General Electric
131	1500	300/600	600	d-c	Geared	Seamless tube mill	U. S. S. R.	U. S. S. R.	General Electric
132	1500	150/300	600	d-c	Geared	83 in. Mill edger	Crucible Steel Company	Midland, Pennsylvania	General Electric
133	1500	375/750	750	d-c	Geared	9-Stand reducing mill	National Tube Company	Lorain, Ohio	General Electric
134	1500	375/750	750	d-c	Geared	9-Stand reducing mill	National Tube Company	Lorain, Ohio	General Electric
135	1500	375/750	750	d-c	Geared	9-Stand reducing mill	National Tube Company	Lorain, Ohio	General Electric
136	1500	375/750	750	d-c	Geared	9-Stand reducing mill	National Tube Company	Lorain, Ohio	General Electric
137	1500	50/90	600	d-c	Direct	Reversing hot brass mill	Laminacao Nationale	Brazil	Westinghouse
138	1500	720	2300	60†	Geared	3-High sheet and plate mill	Ingersoll Steel and Disc Division, Borg-Warner Corporation	Chicago, Illinois	Allis-Chalmers
139	1600③	100/350	600	d-c	Direct	5-Stand tandem cold strip mill	Inland Steel Company	Indiana Harbor, Indiana	General Electric
140	1750	900/560	2300	60	Geared	Rod mill finishing train	Keystone Steel and Wire Company	Peoria, Illinois	General Electric
141	1750	300/600	600	d-c	Geared	26 x 48 in. Continuous billet mill	National Tube Company	Lorain, Ohio	Allis-Chalmers
142	1750	300/600	600	d-c	Geared	26 x 48 in. Continuous billet mill	National Tube Company	Lorain, Ohio	Allis-Chalmers
143	1750	300/600	600	d-c	Geared	26 x 48 in. Continuous billet mill	National Tube Company	Lorain, Ohio	Allis-Chalmers
144	1750	300/600	600	d-c	Geared	26 x 48 in. Continuous billet mill	National Tube Company	Lorain, Ohio	Allis-Chalmers
145	1750	300/600	600	d-c	Geared	26 x 48 in. Continuous billet mill	National Tube Company	Lorain, Ohio	Allis-Chalmers
146	1750	300/600	600	d-c	Geared	26 x 48 in. Continuous billet mill	National Tube Company	Lorain, Ohio	Allis-Chalmers
147	2000	300/600	600	d-c	Geared	66 in. Reversing cold strip mill	Republic Steel Corporation	Massillon, Ohio	Westinghouse
148	2000	300/600	600	d-c	Geared	54 in. Reversing cold strip mill	Republic Steel Corporation	Massillon, Ohio	Westinghouse
149	2000	500/900	600	d-c	Geared	Cold strip mill	Tennessee Coal, Iron and Rail-road Company	Birmingham, Alabama	General Electric
150	2000	514	6600	60*	Geared	Piercing mill	National Tube Company	Lorain, Ohio	General Electric
151	2000	150	6600	60*	Geared	68 in. Hot strip mill roughting stand No. 1	Bethlehem Steel Company	Sparrows Point, Maryland	Allis-Chalmers
152	2500	90/270	750	d-c	Direct	54 in. 4-Stand tandem mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	General Electric
153	2500③	400/800	600	d-c	Geared	Reversing Sendzimir cold mill	Esperance Longdoz	Belgium	General Electric
154	2500②	125/300	600	d-c	Direct	42 in. Tandem cold strip mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	Westinghouse
155	2500③	125/300	600	d-c	Direct	42 in. Tandem cold strip mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	Westinghouse
156	2500	90/270	600	d-c	Direct	54 in. Tandem cold strip mill	Tennessee Coal, Iron and Rail-road Company	Fairfield, Alabama	Westinghouse
157	2500	225/450	750	d-c	Geared	2-Stand, 72 in., cold mill	Aluminum Company of America	Davenport, Iowa	Allis-Chalmers
158	2500	225/450	750	d-c	Geared	72 in. Cold mill	Aluminum Company of America	Alcoa, Tennessee	Allis-Chalmers
159	3000	0/60/120	700	d-c	Direct	32 in. Blooming mill	Bethlehem Pacific Coast Steel Corporation	Los Angeles, California	Allis-Chalmers
160	3000	150/300	750	d-c	Direct	2 Stand, 72 in., cold mill	Aluminum Company of America	Davenport, Iowa	Allis-Chalmers
161	3000	150/300	750	d-c	Direct	1-Stand, 72 in., cold mill	Aluminum Company of America	Davenport, Iowa	Allis-Chalmers
162	3000	150/300	750	d-c	Direct	72 in. Cold mill	Aluminum Company of America	Alcoa, Tennessee	Allis-Chalmers
163	3000③	200/440	600	d-c	Direct	42 in. Tandem cold strip mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	Westinghouse
164	3000③	200/440	600	d-c	Direct	42 in. Tandem cold strip mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	Westinghouse
165	3000③	300/600	600	d-c	Direct	42 in. Tandem cold strip mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	Westinghouse
166	3000③	300/600	600	d-c	Direct	42 in. Tandem cold strip mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	Westinghouse
167	3000	360	11000	60*	Geared	24 in. Billet mill	Crucible Steel Company	Midland, Pennsylvania	General Electric
168	3000	360	11000	60*	Geared	24 in. Billet mill	Crucible Steel Company	Midland, Pennsylvania	General Electric
169	3000③	300/600	600	d-c	Direct	5-Stand tandem cold strip mill	Inland Steel Company	Indiana Harbor, Indiana	General Electric
170	3000③	300/600	600	d-c	Direct	5-Stand tandem cold strip mill	Inland Steel Company	Indiana Harbor, Indiana	General Electric
171	3000③	400/700	600	d-c	Direct	5-Stand tandem cold strip mill	Inland Steel Company	Indiana Harbor, Indiina	General Electric
172	3000③	500/850	600	d-c	Direct	5-Stand tandem cold strip mill	Inland Steel Company	Indiana Harbor, Indiana	General Electric
173	3000③	200/500	600	d-c	Direct	5-Stand tandem cold strip mill	Inland Steel Company	Indiana Harbor, Indiana	General Electric
174	3000	30/60	600	d-c	Direct	132 in. Plate mill	Aluminum Company of America	Davenport, Iowa	General Electric
175	3500	175/350	600	d-c	Geared	5-Stand aluminum hot mill	Aluminum Company of America	Davenport, Iowa	General Electric
176	3500	.....	600	d-c	Geared	5-Stand aluminum hot mill	Aluminum Company of America	Davenport, Iowa	General Electric
177	3500	.....	600	d-c	Geared	5-Stand aluminum hot mill	Aluminum Company of America	Davenport, Iowa	General Electric
178	3500	175/400	600	d-c	Direct	3-Stand tandem mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	General Electric
179	3500	144	6600	60*	Geared	68 in Hot strip mill roughing stand No. 2	Bethlehem Steel Company	Sparrows Point, Maryland	Allis-Chalmers
180	3500	150/300	600	d-c	Direct	68 in. Hot strip mill finishing stand No. 11	Bethlehem Steel Company	Sparrows Point, Maryland	Allis-Chalmers
181	3750③	450/850	600	d-c	Direct	42 in. Tandem cold strip mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	Westinghouse
182	3750③	450/850	600	d-c	Direct	42 in. Tandem cold strip mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	Westinghouse
183	4000②	125/360	600	d-c	Direct	54 in. Tandem cold strip mill	Tennessee Coal, Iron and Rail-road Company	Fairfield, Alabama	Westinghouse
184	4000①	250/600	600	d-c	Geared	54 in. Tandem cold strip mill	Tennessee Coal, Iron and Rail-road Company	Fairfield, Alabama	Westinghouse
185	4000①	250/580	600	d-c	Geared	54 in. Tandem cold strip mill	Tennessee Coal, Iron and Rail-road Company	Fairfield, Alabama	Westinghouse
186	4000	175/350	600	d-c	Geared	5-Stand aluminum hot mill	Aluminum Company of America	Davenport, Iowa	General Electric
187	4000	.....	600	d-c	Geared	5-Stand aluminum hot mill	Aluminum Company of America	Davenport, Iowa	General Electric
188	4000	783	6600	60*	Direct	Hot strip mill	Tennessee Coal, Iron and Rail-road Company	Birmingham, Alabama	General Electric
189	4000	175/350	600	d-c	Geared	Hot strip mill	Tennessee Coal, Iron and Rail-road Company	Birmingham, Alabama	General Electric
190	4000③	125/360	750	d-c	Direct	54 in. 4-Stand tandem mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	General Electric
191	4000③	200/500	750	d-c	Direct	54 in. 4-Stand tandem mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	General Electric
192	4000③	250/580	750	d-c	Direct	54 in. 4-Stand tandem mill	Carnegie-Illinois Steel Corporation	Gary, Indiana	General Electric
193	4000	125/250	600	d-c	Geared	68 in. Hot strip mill finishing stand No. 6	Bethlehem Steel Company	Sparrows Point, Maryland	Allis-Chalmers

ELECTRIC MOTORS OVER THREE HUNDRED HORSEPOWER-(Continued)

Item	Horse power	Revolutions per minute	Volts	Frequency	Method of drive	Kind of mill	Purchaser	Location	Manufacturer
194	4000	125/250	600	d-c	Geared	68 in. Hot strip mill finishing stand No. 7	Bethlehem Steel Company	Sparrows Point, Maryland	Allis-Chalmers
195	4000	80/160	600	d-c	Direct	68 in. Hot strip mill finishing stand No. 8	Bethlehem Steel Company	Sparrows Point, Maryland	Allis-Chalmers
196	4000	100/200	600	d-c	Direct	68 in. Hot strip mill finishing stand No. 9	Bethlehem Steel Company	Sparrows Point, Maryland	Allis-Chalmers
197	4000	125/250	600	d-c	Direct	68 in. Hot strip mill finishing stand No. 10	Bethlehem Steel Company	Sparrows Point, Maryland	Allis-Chalmers
198	4500	257	6600	60*	Geared	68 in. Hot strip roughing stand No. 3	Bethlehem Steel Company	Sparrows Point, Maryland	Allis-Chalmers
199	4500	400	6600	60*	Geared	68 in. Hot strip mill roughing stand No. 4	Bethlehem Steel Company	Sparrows Point, Maryland	Allis-Chalmers
200	4500	400	6600	60*	Geared	68 in. Hot strip mill roughing stand No. 4	Bethlehem Steel Company	Sparrows Point, Maryland	Allis-Chalmers
201	4500	225	13800	60*	Geared	Piercing mill	National Tube Company	Lorain, Ohio	General Electric
202	5000	30/60	525	d-c	Direct	Reversing aluminum plate mill	Aluminum Company of America	Davenport, Iowa	Westinghouse
203	5000	70/170	800	d-c	Direct	Reversing hot strip mill	Crucible Steel Company	Midland, Pennsylvania	General Electric
204	5000	125/245	600	d-c	Direct	Hot strip mill	Geneva Steel Company	Provo, Utah	General Electric
205	5000	150/294	600	d-c	Direct	Hot strip mill	Geneva Steel Company	Provo, Utah	General Electric
206	5000	65/130	700	d-c	Direct	35 x 84 in. Reversing bar mill	National Tube Company	Lorain, Ohio	Allis-Chalmers
207	8000①	40/80	800	d-c	Direct	Blooming mill	National Tube Company	Lorain, Ohio	Westinghouse

*Synchronous †Inducton ①Twin Motor Drive ②Double Armature ③Triple Armature

RECAPITULATION

Company	Location	Type of mill	Number of motors	Total horsepower
Acme Steel Company	Riverdale, Illinois	Tandem cold strip mill	6	6350
Aluminum Company of America	Alcoa, Tennessee]	72 in. Cold mill	3	6750
Aluminum Company of America	Davenport, Iowa	Reversing aluminum plate mill	3	6000
		48 in. Non-reversing cold strip mill	1	1000
		60 in. Non-reversing cold strip mill	1	1250
		72 in., 2-Stand, cold mill	2	5500
		72 in., 1-Stand, cold mill	1	3000
		132 in. Plate mill	1	3000
Aluminum Company of South Africa	South Africa	5-Stand aluminum hot mill	5	18,500
		Aluminum cold sheet mill	1	300
		Reversing hot aluminum mill	1	350
American Brass Company	Buffalo, New York	Sendzimir brass strip mill	1	500
American Rolling Mill Company	Butler, Pennsylvania	Tandem cold strip mill	5	4900
Bethlehem Steel Company	Lackawanna, New York	Skin pass cold strip mill	1	500
	Sparrows Point, Maryland	32 in. Temper pass mill	2	600
		2-Stand temper pass mill	12	4800
		68 in. Hot strip mill	13	43,800
Bethlehem Pacific Coast Steel Corporation	Vernon, California	Rod and merchant mill	10	8100
Carnegie-Illinois Steel Corporation	Gary, Indiana	3-Stand tandem mill	2	4500
		54 in., 4-Stand tandem mill	5	15,500
Chase Brass and Copper Company	Cleveland, Ohio	Two 42 in. Tandem cold strip mills	12	28,400
		Single stand mills	2	1000
Columbia Steel Company	Pittsburg, California	Brass piercing mill	1	600
		42 in. Temper pass mill	6	3300
Crucible Steel Company of America	Midland, Pennsylvania	60 in. Temper pass mill	2	1300
		Rod mill	4	2350
		24 in. Billet mill	2	6000
		Reversing hot strip mill	1	5000
Esperance-Longdoz	Belgium	83 in. Mill edger	1	1500
		Reels	4	4000
Geneva Steel Company	Provo, Utah	Reversing Sendzimir cold mill	1	2500
Ingersoll Steel and Disc Division, Borg-Warner Corporation	Chicago, Illinois	Hot strip mill	2	10,000
Inland Steel Company	Indiana Harbor, Indiana	3-High sheet and plate mill	1	1500
		72 in. Temper pass mill	4	3200
		54 in. Temper pass mill	2	1600
Kaiser Company	Fontana, California	5-Stand tandem cold strip mill	7	17,400
Keystone Steel and Wire Company	Peoria, Illinois	24 in. Reversing cold strip mill	3	1600
Laclede Steel Company	Alton, Illinois	Rod mill finishing train	1	1750
Laminacao Nationale	Brazil	Rod mill	4	1700
		Reversing cold brass strip mill	3	1800
Latrobe Electric Steel Company	Latrobe, Pennsylvania	Reversing hot brass mill	1	1500
National Tube Company	Gary, Indiana	Bar mill	1	600
		Piercing mill	1	2000
		8-Stand reducing mill	6	5000
	Lorain, Ohio	Sizing mill	1	500
		Blooming mill	1	8000
		35 x 84 in. Reversing bar mill	1	5000
		4-Stand, 20 x 36 in., continuous billet mill	4	5000
		6-Stand, 20 x 36 in., continuous billet mill	6	10,500
		Piercing mill	1	4500
		9-Stand reducing mill	9	8500
Republic Steel Corporation	Massillon, Ohio	54 in. Reversing cold strip mill	3	3200
		66 in. Reversing cold strip mill	3	3200
Revere Copper and Brass Company	Detroit, Michigan	4-High, 2-stand tandem mill	1	400
Reynolds Metals Company	Louisville, Kentucky	Cold mill	1	600
Sharon Steel Corporation	Sharon, Pennsylvania	29 in. Reversing cold mill	3	2500
Sheffield Steel Corporation	Kansas City, Missouri	Rod and merchant mill	10	5300
Tennessee Coal, Iron and Railroad Company	Birmingham, Alabama	Cold strip mill	1	2000
	Fairfield, Alabama	Hot strip mill	2	8000
		54 in., 5-Stand tandem cold strip mill	5	15,300
Thompson Wire Company	Franklin Park, Illinois	20 in. Reversing cold mill	1	600
U. S. S. R.	U. S. S. R.	Seamless tube mill	4	3200
	Zaporojstal	Cold mill reel	1	500
Winchester Repeating Arms Company	New Haven, Connecticut	Brass strip mill	1	500

Types of motors purchased	Number of motors	Total horsepower
Alternating current motors	16	41,650
Direct current motors	191	286,650
Total	207	328,300

LOYAL R. MILBURN

PRESIDENT 1947

ASSOCIATION OF IRON AND STEEL ENGINEERS

L. R. MILBURN was born in Patoka, Indiana and was graduated from the University of Michigan with a degree of electrical engineering in June, 1918. From July, 1918, until 1919 he went with the General Electric Company doing testing, complaint, installation, and apparatus sales work. In March 1925, he moved to the Louisville Gas and Electric Company where he did construction work until October, 1929, obtaining excellent knowledge of the workings of the central station industry. Starting his steel mill career in October, 1929, with the Great Lakes Steel Corporation as electrical draftsman, Mr. Milburn remained in this position until 1933 when he was appointed acting electrical engineer. In 1935 he was promoted to electrical engineer.

The President's Message

I feel deeply honored to be entrusted with the presidency of the Association of Iron and Steel Engineers for 1947 — the 40th anniversary of its founding. Throughout these 40 years, the basic policy of this Association has been the interchange of ideas and information for the benefit of the iron and steel industry.

The value of this organization to the steel industry and to the country as a whole was well demonstrated during the past six years in connection with the war effort. Now, during postwar reconversion, modernization and alterations call for the best of engineering skill and supervision. We will do our best to meet this challenge.

With the help of the officers and members of the Association, I feel certain that we will make 1947 a new peak in our 40-year history of achievement and progress.

Loyal R. Milburn

President

A. J. FISHER
First Vice President

C. H. WILLIAMS
Second Vice President

A. S. GLOSSBRENNER
Treasurer

NEWLY ELECTED AISE

Officers and Directors

1947

A. J. FISHER was graduated from the Colorado State preparatory school and later from the University of Colorado, college of engineering, with a degree in mechanical engineering. Mr. Fisher began his steel mill employment with the Bethlehem Steel Company at the Maryland plant as assistant master mechanic of the sheet and tin mill division in 1924. After serving in several capacities in various departments, Mr. Fisher became fuel engineer in 1929, holding that position at the present time.

▲

C. H. WILLIAMS was graduated from the University of Colorado in 1926 and was employed by Jones and Laughlin Steel Corporation as shear foreman in their Pittsburgh plant. In 1927 he became a junior engineer in the power department of National Tube Company at Pittsburgh, shifting in 1930 to the Ohio Works of Carnegie Steel Company. Here he served successively as junior engineer, power and fuel engineer, and assistant chief engineer. In 1940 Mr. Williams was transferred to the Pittsburgh Office of Carnegie-Illinois Steel Corporation as power and fuel engineer on the staff of the chief engineer, and was subsequently appointed assistant chief engineer of the Pittsburgh District. In 1941 he was placed in charge of a newly organized defense engineering staff to coordinate the engineering of defense steel plant expansions of the company in the Pittsburgh district. He was subsequently transferred to the United States Steel Corporation of Delaware as assistant to the vice president of engineering, and in 1943 to chief engineer of the Pittsburgh district, Carnegie-Illinois Steel Corporation.

▲

ALBERT S. GLOSSBRENNER attended the University of Wisconsin and later entered the employ of the old Illinois Steel Company, one of the predecessors of Carnegie-Illinois Steel Corporation, at the Gary, Indiana tin plate plant. He then transferred to the same company's South Works at Chicago as assistant foreman. Five years later he joined Youngstown Sheet and Tube Company at Youngstown, Ohio, as assistant superintendent of the hot strip mill, becoming superintendent about three years later. He was appointed superintendent of the Brier Hill plant in September, 1942, and in 1943 was named general superintendent of the Youngstown district of The Youngstown Sheet and Tube Company. In December, 1946, Mr. Glossbrenner was named assistant vice president of operations.

▲

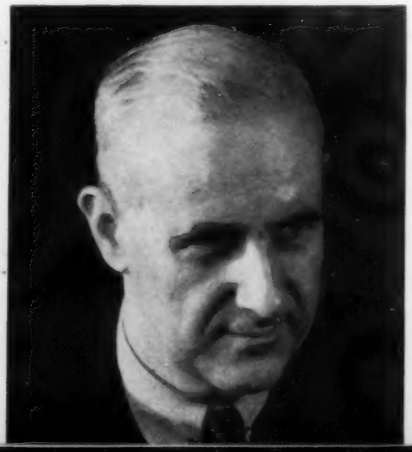
JOHN F. BLACK received his elementary schooling in the Enid, Oklahoma, city schools, and attended the United States Naval Academy, class of 1926. He started in the steel business as pipefitter helper at Bethlehem Steel Company's Sparrows Point plant, progressing to steel shipper, labor foreman, gashouse foreman, general foreman of gas producers, combustion engineer, and general foreman of pipe mills. In 1941 he transferred to Atlas Steels Limited, Welland, Ontario, as fuel engineer and in 1943 was made assistant works manager. In January 1947, Mr. Black was appointed general superintendent, Buffalo plant, Wichwire Spencer Steel division of the Colorado fuel and Iron Corporation.

▲

I. N. TULL was born in Anniston, Alabama, reared in North Carolina, and graduated from North Carolina State College in electrical engineering in 1910. After a brief period of telephone work, he entered General Electric Company's test course at Schenectady. He was transferred to their Cleveland office's engineering department in 1912, remaining there until 1915, when he was employed by Corrigan, McKinney and Company as electrical engineer. The next 12 years were spent in engineering and construction work as that company built blast furnaces and a steel plant at Cleveland, Ohio and proceeded with extensive electrification of their iron mines and the opening of coal mines. In 1927, general supervision of electrical maintenance and operations was added to the construction duties. After the merger with Republic Steel Corporation in 1935, Mr. Tull became electrical superintendent of the Cleveland District for Republic.

J. F. BLACK
Secretary

I. N. TULL
Director-at-Large



ACEL GARLAND
Director

H. E. DAVIS
Director

A. B. GLOVER
Director

FRANK E. ROBINSON
Director

ACEL GARLAND attended Oklahoma A & M College and Oklahoma University, finishing in electrical engineering in 1928. He was employed by the Western Electric Company at their Kearny New Jersey plant as a trainee in manufacturing engineering in 1928. From 1933 to 1936 he was engaged in constructing and operating a diesel electric light and power system for the city of Burkburnett, Texas. He returned to the Western Electric Company in January 1937. In 1939, he moved to the Tennessee Coal, Iron and Railroad Company in Birmingham, Alabama, as an industrial engineer supervising time study work. Since that time he has advanced to his present position of supervising engineer — production standards and incentives for the company.

▲

HENRY E. DAVIS, superintendent of maintenance for Republic Steel Corporation at Buffalo, New York, was born in Kansas and attended Chicago public schools. He began work with Illinois Steel Company at South Chicago in 1900. Following an apprentice course there, he worked at various times for Bussington Cement Company, Inland Steel Company, Wisconsin Steel Company and Colorado Fuel and Iron Company. In 1912 he joined Interstate Iron and Steel Company as chief electrician, and remained through that Company's mergers with Central Alloy Steel Corporation and Republic Steel Corporation. In 1935 he was transferred to Republic's Buffalo district.

▲

ARTHUR B. GLOVER was born in Bogard, Missouri, where he received his early schooling, graduating in electrical engineering from University of Missouri in 1926. Following brief periods with Union Electric Light and Power Company and General Electric Company, he became assistant electrical superintendent for Acme Steel Company, Chicago, Illinois.

▲

FRANK E. ROBINSON was born in Lima, Ohio and a few years later moved to Birmingham, Alabama, where he attended public schools and technical high school. During the first world war he was employed by Tennessee Coal, Iron & Railroad Company as a draftsman on the construction of the first units of Fairfield works. In 1920 he came to Cleveland with Otis Steel Company as chief draftsman in the blast furnace division, and completed a night school course in mechanical engineering at John Huntington Polytechnic Institute. In 1925 he began working for American Steel & Wire Company as designer-checker, later being advanced to section head draftsman, assistant construction engineer and in 1945 to a newly created position of division engineer of projects.

C. E. S. EDDIE was born in Oban, Scotland, in 1905, graduating from Whitehill Higher Grade School, Glasgow, in 1921, and from Royal Technical College Glasgow in 1927. He started with the English Electric Company as an estimator and then served a regulation engineering apprenticeship with the Steel Company of Scotland, Blochairn Works, Glasgow.

He came to America and was employed as a draftsman by the Pennsylvania Salt Company in Wyandotte, Michigan, was advanced to the position of power plant engineer, and later became master mechanic in charge of all electrical and mechanical equipment. In 1938, he was employed by Great Lakes Steel Corporation, Ecorse, Michigan, in the engineering department and was later transferred to the steam and fuel department, where he became plant lubrication engineer, and in 1944, was promoted to his present position of assistant superintendent of the steam and fuel department.

▲

AARON D. HOWRY was born in Lancaster County, Pennsylvania, and upon completion of grade and high schools, joined the student engineering course of the Westinghouse Electric and Manufacturing Company at East Pittsburgh, furthering his education in night school. He was later assigned to the automatic and supervisory control department of switchboard engineering.

In 1928 he joined the engineering department of the Philadelphia Electric Company, and in 1934 transferred to the chief engineer's force of the Pennsylvania Railroad, as chief inspector of substations on electrification projects.

In 1940 he moved to the position of electrical engineer for Alan Wood Steel Company, Conshohocken, Pennsylvania, progressing to assistant chief engineer and then to plant engineer. He is now assistant superintendent of maintenance, in charge of electrical work at the Alan Wood plant.

▲

ALEX MONTGOMERY, JR., was graduated from University of Kentucky in 1928 and was employed by The American Bridge Company as a structural engineer at their Ambridge, Pennsylvania, plant. In 1934 he was transferred to the operating department in industrial engineering work. In 1935 he transferred to the American Sheet and Tin Plate Company, serving as plant industrial engineer from 1935 to 1937. Moving to Duquesne Works of Carnegie-Illinois Steel Corporation in 1937, he served successively as plant industrial engineer, superintendent of bar mills, superintendent of rolling, and in 1944 was made assistant general superintendent.

C. E. S. EDDIE
Director

A. D. HOWRY
Director

ALEX MONTGOMERY, JR.
Director

LELAND S. STEINER
Director

E. W. TREXLER
Director

J. H. STRASSBURGER
Director

LELAND S. STEINER was born in Canton, Ohio, where he received his grammar and high school education, later taking a night course at The Case School of Applied Science.

After several years each with the United Electric Company, Canton Electric Company, and Canton Sheet Steel Company, he joined the Central Steel Company in Massillon in 1922, leaving this company in 1925 to join the steel and tube division of Timken Roller Bearing Company as foreman of electrical construction. He was appointed superintendent of the electrical department in 1938, and in 1945, following the consolidation of the maintenance departments, was appointed assistant superintendent of maintenance.

▲

E. W. TREXLER was born in Allentown, Pennsylvania, and was graduated from Lehigh University in 1912 in mechanical engineering. From 1912 until 1917 he was employed by the Ingersoll-Rand Company at Painted Post, New York. He has been at Cambria plant, Bethlehem Steel Company, since 1917, serving in various capacities until appointed to his present position of superintendent of the mechanical department.

▲

J. H. STRASSBURGER was graduated from Stevens Institute of Technology, Class of 1921 with the degree of mechanical engineer. From June 1921 until June 1922 he was instructor in the department of chemistry at Stevens Institute.

In June 1922 he was appointed fuel engineer at the Bethlehem Steel Company at Bethlehem, Pennsylvania. He became combustion engineer at Weirton Steel Company, Weirton, West Virginia in April 1924. In December 1942 he was appointed manager, department of service and maintenance for the Weirton Steel Company, Weirton, West Virginia.

JOHN L. YOUNG is a native of Evansville, Indiana and graduated from the University of Indiana. Mr. Young began his career with the Timken Roller Bearing Company in Canton, Ohio, where he held various positions in the alloy tube and steel departments; he later transferred to the metallurgical department.

In 1930, Mr. Young went to Pittsburgh for Timken as a development engineer, and later returned to Canton and became assistant general manager of Timken's industrial division.

Mr. Young joined the United Engineering and Foundry Company, Pittsburgh, Pennsylvania in 1936. In 1941, he was loaned as project manager to design and construct the Defense Plant Corporation's aluminum rolling mills at Trentwood, Washington. He was vice president in charge of industrial research and development of United Engineering and Foundry Company, before assuming his present position as vice president in charge of engineering of United States Steel Corporation's National Tube Company in 1945.

▲

C. E. PRITCHARD was graduated from Carnegie Institute of Technology in June 1932. Upon graduation he joined the lubrication department of the Atlantic Refining Company, leaving in August, 1937 to join the mechanical department at the Warren district of the Republic Steel Corporation. Here he served in the capacity of oiler and millwright until July 1938, when he assumed the duties of lubrication engineer of the Warren district. In March 1941, he was advanced to his present position of chief lubrication engineer of all Republic operations.

▲

JOHN B. MITCHELL'S entire business career has been in the steel industry. He started with Jones and Laughlin Steel Corporation on September 1, 1915 in the Aliquippa works machine shop, became assistant steam engineer and later superintendent of the 14 in. mill.

For eight years, Mr. Mitchell was superintendent of the rolling mills at the Jones and Laughlin Pittsburgh works. On January 1, 1946, he assumed the position of assistant to the operating vice president of Jones and Laughlin Steel Corporation and later the same year was appointed general manager of manufacturing operations.

JOHN L. YOUNG
Director

C. E. PRITCHARD
Director

J. B. MITCHELL
Director

National Committees for 1947

ASSOCIATION OF IRON AND STEEL ENGINEERS

General Chairman, L. R. Milburn

ADVISORY COMMITTEE

Past Presidents, A.I.S.E.

1907-1908 JAMES FARRINGTON, *Electrical Superintendent*, Wheeling Steel Corporation, Steubenville, Ohio.

1909 JOHN C. REED, *Electrical Superintendent*, Bethlehem Steel Company, Steelton, Pennsylvania.

1910 F. P. TOWNSEND, *Technical Assistant*, Copperweld Steel Company, Glassport, Pennsylvania.

1914 E. FRIEDLANDER (Retired), Los Angeles, California.

1919 D. M. PETTY, *President*, Philadelphia, Bethlehem and New England Railroad Company, Bethlehem, Pennsylvania.

1921 E. S. JEFFRIES, *General Manager*, Universal Boring Machine Company, Hudson, Massachusetts.

1922 W. S. HALL, *Chief Engineer*, Chicago District, Carnegie-Illinois Steel Corporation, Chicago, Illinois.

1923 R. B. GERHARDT, *Chief Engineer of Construction*, Bethlehem Steel Company, Bethlehem, Pennsylvania.

1924 R. S. SHOEMAKER, *Lubrication Engineer*, American Rolling Mill Company, Middletown, Ohio.

1925 A. C. CUMMINS, *General Superintendent*, Youngstown District, Carnegie-Illinois Steel Corporation, Youngstown, Ohio.

1926 G. H. SCHAEFFER, *Electrical Engineer*, Carpenter Steel Company, Reading, Pennsylvania.

1927 S. S. WALES, *Assistant to President and Plant Engineer*, Youngstown Welding & Engineering Company, Youngstown, Ohio.

1930 F. W. CRAMER, *Electrical Engineer*, Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania.

1931 F. O. SCHNURE, *Electrical Superintendent*, Bethlehem Steel Company, Sparrows Point, Maryland.

1932 J. J. BOOTH, *Superintendent of Maintenance*, Carnegie-Illinois Steel Corporation, Duquesne, Pennsylvania.

1933 *Chairman:* J. D. DONOVAN (Retired), Massillon, Ohio.

1935 W. H. BURR, *Electrical Superintendent*, Lukens Steel Company, Coatesville, Pennsylvania.

1937 H. G. R. BENNETT, *Engineer*, Hot Rolling Mills, Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania.

1938 L. F. COFFIN, *Superintendent*, Mechanical Department, Bethlehem Steel Company, Sparrows Point, Maryland.

1939 C. CLARKE WALES, Engineering Department, National Tube Company, Pittsburgh, Pennsylvania.

1940 J. A. CLAUSS, *Vice President in Charge of Engineering*, Great Lakes Steel Corporation, Ecorse, Detroit, Michigan.

1941 W. A. PERRY, *Superintendent, Electrical and Power Departments*, Inland Steel Company, East Chicago, Indiana.

1943 F. E. FLYNN, *District Manager*, Republic Steel Corporation, Warren, Ohio.

1944 CHAS. L. McGRANAHAN, *Assistant General Superintendent*, Jones and Laughlin Steel Corporation, Pittsburgh Works, Pittsburgh, Pennsylvania.

1945 J. L. MILLER, *Assistant Chief Combustion Engineer*, Republic Steel Corporation, Cleveland, Ohio.

1946 FREEMAN H. DYKE, *Assistant General Manager*, Wheeling Steel Corporation, Steubenville, Ohio.

MEMBERSHIP COMMITTEE

Chairman: A. J. FISHER, *Fuel Engineer*, Bethlehem Steel Company, Sparrows Point, Maryland.

ACEL GARLAND, *Supervisor Incentive Section*, Tennessee Coal, Iron and Railroad Company, Birmingham, Alabama.

J. H. STRASSBURGER, *Manager Service and Maintenance*, Weirton Steel Company, Weirton, West Virginia.

HARRY W. CLARK, *Metallurgical Engineer*, Ford Motor Company, Dearborn, Michigan.

O. P. ASHURST, *Engineer*, Giffels and Vallet, Inc., Detroit, Michigan.

PAUL E. THOMAS, *Assistant Electrical Engineer*, Carnegie-Illinois Steel Corporation, Gary, Indiana.

V. S. ACTON, *Manager Metal Working Section*, Westinghouse Electric Corporation, Chicago, Illinois.

J. V. HALLDIN, *Roll Designer*, Republic Steel Corporation, Buffalo, New York.

B. L. DONAHUE, *District Manager*, Cutler-Hammer, Inc., Buffalo, New York.

O. A. BAMBERGER, *Superintendent Massillon Steel Division*, Republic Steel Corporation, Massillon, Ohio.

ALBERT J. HULSE, *Chief Engineer*, Youngstown Sheet and Tube Company, Youngstown, Ohio.

R. J. WEAN, *President*, Wean Engineering Company, Inc., Warren, Ohio.

J. B. MITCHELL, *General Manager of Manufacturing Operations*, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania.

ROBERT WHITEHILL, *District Manager*, Clark Controller Company, Pittsburgh, Pennsylvania.

J. J. BANGERT, *Division Sales Manager*, Crouse-Hinds Company, Pittsburgh, Pennsylvania.

W. N. HORKO, *Engineer*, Henry Disston & Sons, Inc., Tacony, Pennsylvania.

E. P. O'NEILL, *Engineer*, Hyatt Bearings Division, General Motors Corporation, Washington, D. C.

R. L. DOWELL, *Maintenance Foreman Tin Mill*, Tennessee Coal, Iron and Railroad Company, Fairfield, Alabama.

J. W. WILSON, *Salesman*, National Carbon Company, Inc., Atlanta, Georgia.

STANDARDIZATION COMMITTEE

General Chairman: F. W. CRAMER, *Electrical Engineer*, Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania.

W. T. ADAMS, *General Purchasing Agent*, Republic Steel Corporation, Cleveland, Ohio.

E. L. ANDERSON, *Electrical Superintendent*, Bethlehem Steel Company, Johnstown, Pennsylvania.

. J. BOOTH, *Superintendent of Maintenance*, Carnegie-Illinois Steel Corporation, Duquesne, Pennsylvania.

L. F. COFFIN, *Superintendent, Mechanical Department*, Bethlehem Steel Company, Sparrows Point, Maryland.

H. B. CONOVER, *Repair and Maintenance Engineer*, Carnegie-Illinois Steel Corporation, Carnegie Building, Pittsburgh, Pennsylvania.

WM. B. FERGUSON, *Electrical Engineer*, Carnegie-Illinois Steel Corporation, South Chicago, Illinois.

A. J. FISHER, *Fuel Engineer*, Bethlehem Steel Company, Sparrows Point, Maryland.

R. W. GRAHAM, *Electrical Superintendent*, Bethlehem Steel Company, Lackawanna, New York.

F. E. KLING, *Steel Mill Engineer*, Youngstown, Ohio.

C. L. McGRANAHAN, *Assistant General Superintendent*, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania.

J. B. MITCHELL, *General Manager of Manufacturing Operations*, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania.

H. W. NEBLETT, *Special Engineer*, Inland Steel Company, East Chicago, Indiana.

C. E. PRITCHARD, *Lubrication Engineer*, Republic Steel Corporation, Cleveland, Ohio.

F. O. SCHNURE, *Electrical Superintendent*, Bethlehem Steel Company, Sparrows Point, Maryland.

C. H. WILLIAMS, *Chief Engineer*, Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania.

Special Committees appointed when and as required.

MEETINGS AND EDITORIAL COMMITTEE

Chairman: L. R. MILBURN, *President*, AISE.

M. B. ANTRIM, *Chairman*, Electrical Engineering Division.

C. W. BRUCE, *Chairman*, Combustion Engineering Division.

J. H. VOHR, *Chairman*, Operating Practice Division.

H. W. NEBLETT, *Chairman*, Mechanical and Welding Division.

C. R. HAND, *Chairman*, Lubrication Engineering Division.

ANDERS G. ERICSON, *Chairman*, Rolling Mill Division.

ELECTRICAL ENGINEERING DIVISION

Chairman: M. B. ANTRIM, *Technical Assistant to Electrical Superintendent*, Lukens Steel Company, Coatesville, Pennsylvania.

I. N. TULL, *Electrical Superintendent*, Republic Steel Corporation, Cleveland, Ohio.

A. D. HOWRY, *Electrical Engineer*, Alan Wood Steel Company, Conshohocken, Pennsylvania.

V. E. SCHLOSSBERG, *Superintendent, Electric and Power Department*, Inland Steel Company, East Chicago, Indiana.

H. L. COE, *Assistant Maintenance Superintendent*, Carnegie-Illinois Steel Corporation, Clairton, Pennsylvania.

JOHN E. BUTLER, *Electrical Engineer*, Weirton Steel Company, Weirton, West Virginia.

D. C. NELSON, *Assistant Electrical Engineer*, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania.

C. E. HOMER, *Electrical Superintendent*, Youngstown Sheet and Tube Company, East Chicago, Indiana.

COMBUSTION ENGINEERING DIVISION

Chairman: C. W. BRUCE, *Combustion Engineer*, Republic Steel Corporation, Chicago, Illinois.

BRUCE B. BARGMAN, *Superintendent Fuel*, Carnegie-Illinois Steel Corporation, Munhall, Pennsylvania.

HENRY S. HALL, *Fuel Engineer*, Lukens Steel Company, Coatesville, Pennsylvania.

CARL F. MENGES, *Fuel Engineer*, Pittsburgh Steel Company, Monessen, Pennsylvania.

CARL M. YAEGER, *Combustion Engineer*, Otis Steel Division, Jones and Laughlin Steel Corporation, Cleveland, Ohio.

EVERETT C. HITE, *Combustion and Refractories Engineer*, Steel and Tube Division, Timken Roller Bearing Company, Canton, Ohio.

JOHN J. ALEXANDER, *Assistant Superintendent Power*, Republic Steel Corporation, Corrigan-McKinney Plant, Cleveland, Ohio.

C. E. DUFFY, *Assistant Fuel Engineer*, Bethlehem Steel Company, Sparrows Point, Maryland.

OPERATING PRACTICE DIVISION

Chairman: J. H. VOHR, *Assistant General Superintendent*, Carnegie-Illinois Steel Corporation, South Works, Chicago, Illinois.

JOHN B. HILL, *Superintendent Blast Furnace*, Bethlehem Steel Company, Lackawanna, New York.

J. L. TATMAN, *Metallurgist*, Wheeling Steel Corporation, Steubenville, Ohio.

P. E. HAGLUND, *Melting Superintendent*, Ford Motor Company, Dearborn, Michigan.

C. P. BETZ, *Assistant Manager*, Great Lakes Steel Corporation, Hanna Furnace Division, Ecorse, Detroit, Michigan.

ROY P. TOOKE, *General Superintendent*, American Rolling Mill Company, Butler, Pennsylvania.

ACEL GARLAND, *Supervisor Incentive Section*, Tennessee Coal, Iron and Railroad Company, Birmingham, Alabama.

MECHANICAL AND WELDING DIVISION

Chairman: H. W. NEBLETT, *Special Engineer*, Inland Steel Company, East Chicago, Indiana.

F. S. ECKHARDT, *Chief Engineer*, Bethlehem Steel Company, Lackawanna, New York.

H. B. CONOVER, *Repair and Maintenance Engineer*, Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania.

A. J. GREENSLADE, *Master Mechanic*, Ohio Seamless Tube Company, Shelby, Ohio.

ALBERT J. HULSE, *Chief Engineer*, Youngstown Sheet and Tube Company, Youngstown, Ohio.

PAUL L. WALTER, *Mechanical Superintendent*, Republic Steel Corporation, Canton, Ohio.

JAMES J. HEALY, *Senior Mechanical Engineer*, American Rolling Mill Company, Middletown, Ohio.

LEO J. GOULD, *Assistant Chief Engineer of Construction*, Bethlehem Steel Company, Bethlehem, Pennsylvania.

LUBRICATION ENGINEERING DIVISION

Chairman: C. R. HAND, *Lubrication Engineer*, Bethlehem Steel Company, Sparrows Point, Maryland.

D. N. EVANS, *Lubrication Engineer*, Inland Steel Company, East Chicago, Indiana.

C. E. PRITCHARD, *Lubrication Engineer*, Republic Steel Corporation, Cleveland, Ohio.

R. A. BARTA, *Mechanical Foreman*, 88 In. Hot Strip Mill, Republic Steel Corporation, Corrigan-McKinney Works, Cleveland, Ohio.

H. R. GRAVENSTRETER, *Superintendent Maintenance*, Carnegie-Illinois Steel Corporation, Youngstown, Ohio.

WILLIAM E. HYDE, *Lubrication Engineer*, Wheeling Steel Corporation, Steubenville, Ohio.

R. S. SHOEMAKER, *Lubrication Engineer*, American Rolling Mill Company, Middletown, Ohio.

T. R. MOXLEY, *General Master Mechanic*, Wheeling Steel Corporation, Steubenville, Ohio.

ROLLING MILL DIVISION

Chairman: ANDERS G. ERICSON, *Chief Engineer*, Homestead Steel Works, Carnegie-Illinois Steel Corporation, Munhall, Pennsylvania.

C. W. BARRETT, *Roll Designer*, Republic Steel Corporation, Chicago, Illinois.

LOUIS MOSES, *Superintendent, Rail and Roll Mills*, Bethlehem Steel Company, Sparrows Point, Maryland.

H. A. CARTER, *Superintendent Roll Department*, Bethlehem Steel Company, Lackawanna, New York.

JOHN A. SCHOLL, *Chief Roll Designer*, Tennessee Coal, Iron and Railroad Company, Fairfield, Alabama.

WADE F. HOFFMAN, *Superintendent Roll Department*, Jones and Laughlin Steel Corporation, Aliquippa, Pennsylvania.

D. W. LLOYD, *Superintendent Rolling Mills*, Youngstown Sheet and Tube Company, Brier Hill Works, Youngstown, Ohio.

S. WILLIAM STOUFFER, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania.

JOHN L. YOUNG, *Vice President of Engineering*, National Tube Company, Pittsburgh, Pennsylvania.

Metal Powder Self-Lubricating Bearings

. . . . in the oil cushion bearing, the factors of gravity, pressure, etc., which in a solid bearing are a liability, cause the oil film to be generated and established . . . .

by A. J. Langhammer

PRESIDENT, AMPLEX DIVISION

CHRYSLER CORPORATION

DETROIT, MICHIGAN

▲ THE art of making bearings from metal powder is new. Industrial progress began in the late twenties with the invention and release of Oilite bronze. This product filled a long felt need and made available to industry a new, general purpose, heavy duty bearing that was also self-lubricating.

The prime purpose of any bearing is to support the load and permit the shaft, or journal, to revolve with the minimum of friction. However, successful bearing operation exists only when an oil film, or a similar medium, separates the journal from the bearing so that there is no metal to metal contact.

Specifications for bearings, as a general rule, are written in terms of composition and physical properties; therefore, recognition of the fact that self-lubricating bearings are porous may lead to the erroneous assumption that, under performance, they are weaker than solid members of corresponding size and composition. This is not a fact. Nothing is further from actuality, because oil cushion bearings operate under the principles of hydraulics rather than mechanics. This is due to the fact that the many tiny inter-connecting pores are filled with a liquid lubricant forming a hydraulic cushion, resulting in a bearing of enormously increased strength.

Oil cushion bearings offer advantages and economies that are cumulative in character. These include:

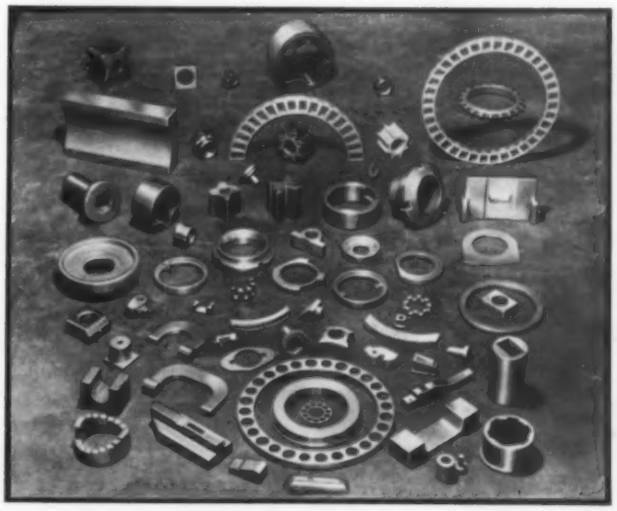
1. Top performance.
2. High factor of safety.
3. Oil filtering.
4. Longevity.
5. Higher quality through closer tolerances.
6. Ease of assembling and finishing the bore.
7. Exceptionally high purity of materials.
8. Short tool up time.
9. No price penalty.

In the operation of a solid bearing, gravity, pressure, impact and friction tend to dissipate and destroy the oil film between the journal and the bearing. In an oil cushion bearing these factors become a potent asset rather than a liability, and cause an oil film to be generated and established. No leakage occurs. Contrast this to a statement by qualified experts that as high as ninety per cent of all lubricating oil used is wasted and performs no useful work.

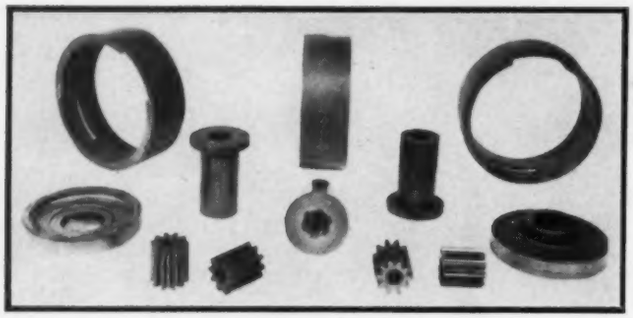
Anti-friction bearings, too, are solid in nature, and the use of self-lubricating retainers has created new standards in performance and life of thrust ball bearings.

Whereas self-lubricating bearings are not the answer to all bearing problems, it is wise to consider their use, and we are frequently surprised at the calibre of duty they successfully perform. One example is thrust application with a known instantaneous load of one hundred thousand psi, which found in oil cushion bronze, having

Miscellaneous series of metal powder, ferrous and non-ferrous machine parts.



Presented before AISE Annual Spring Conference, Chicago, Illinois, May 6, 1946



Miscellaneous ferrous machine parts.

a normal capacity of ten thousand pounds per square inch, a satisfactory solution.

Americans are justly proud of their industries. They are the most highly mechanized in the world, and industries are increasing mechanization at a rapid rate. More and more bearings are being used. It is a most comfortable feeling to know that, though additional lubrication is normally required every twenty-four hours, the operator may, with an oil cushion bearing, omit the oiling service for days and weeks without any harm being done. Sometimes, through error, or conditions beyond the designing engineer's control, the bearing area must be skimped, and here again self-lubricating bearings provide invaluable factors of safety. In one problem, a small gear train on an instrument of top priority was found to develop a thrust. There was no room for a thrust bearing. The engineer was resourceful. He replaced three steel rivets in the gear cluster with three rivets of oil cushion bronze and found that the heads of these rivets provided the necessary thrust.

There are many applications where dust, dirt, lint, even abrasives, are thickly scattered through the atmosphere in which a bearing must operate. Self-lubricating bearings are a natural and ideal filter. We have equipped a lathe spindle with oil cushion bronze, drilled a hole through the housing that led through to the back, or outside diameter of the bearing, and deliberately fed oil that was heavily charged with dirt of all kinds, including powdered emery and carborundum, into the hole. Nothing but clean and pure oil ever reached the bearing surface proper.

Many bearing installations are quite inaccessible. Design factors often dictate that for appearance or streamlining, no oil cups may be used. Other products must have bearings requiring no attention for a long period at a time, and some permit none at all. Oil cushion bearings on a ¾ in. shaft operating at eighteen hundred rpm were run continuously for more than a billion revolutions without exhausting the oil in the bearing. Scientists have computed that only an incredibly small quantity of oil is necessary to properly lubricate a bearing. Oil cushion bearings carefully meter the life-giving oil film and reabsorb same when the bearing is not operating.

More and more mechanisms are being manufactured to interchangeable and precision tolerances. Oil cushion bearings permit very low bearing clearances. On a shaft ¼ in. in diameter, they may be of the order of two ten thousandths of an inch; on a 1¾ in. shaft, clearances may be five ten thousandths of an inch, compared to a normal of three to six times that amount. This makes for improved accuracy over a long period of time, and also greatly reduced noise. On many products the feature of a low noise value is highly desirable.

Unlike a solid bearing of cast bronze, for example, an oil cushion bearing may be mounted on a stub arbor and not only assembled but sized on the bore. Similarly during this operation, an oil film is generated permitting ready withdrawal of the arbor, and also providing for a uniform size at the bore without bell-mouthing or other defects normally present except when the hole is diamond bored. Of course, this operation is not only simple, but greatly reduces the cost of finishing the bore.

Materials used in self-lubricating bearings are of the highest purity. Copper and tin are of the order of 99.5 plus per cent. In purity, this is a higher standard than normally achieved in solid bearings, and the self-lubricating units are virtually phosphor bronze.

In a very short time, standard self-lubricating bearings may be tooled for production. This conserves floor space for machine tools, jigs and fixtures, and tooling time on the part of the vendee. In our own case, production tools for thousands of bearings of different sizes are already available, and these are being constantly augmented. When tools are required for a plain type bearing, the tooling time averages two weeks, and in case of an emergency may be reduced to twenty-four hours.

Naturally, the question arises "How costly are these self-lubricating bearings?" Happily, the answer is favorable. Normally there is no price penalty. On the contrary, as bearings become larger, and particularly if they are flange or thrust type, attractive savings are made.

A word about how these bearings are made. The raw material is a very fine powder of the order of 250 mesh.

This is the largest oil cushion bearing ever built. It weighs 233 lb.

This oil cushion cored and bar stock is used for repair and development work.

Manufacturing operations consist of briquetting to shape, heat treating through sintering, sizing to proper dimensions, and oil impregnation. Plain bearings, flange bearings, thrust bearings, self-aligning bearings, and many units of special shape and size are made from available production tools. In size, our products vary from 1/16 in. in diameter to 18 in. in diameter. The weight of these individual bearings is from ten thousand to a pound to two hundred thirty-three pounds each. Standard sizes are stocked in many industrial centers throughout the United States, and these distributors also carry cored and bar stock.

For emergency repairs, for general maintenance, and for designing and development engineering, this oil cushion bronze in bars and cored units, readily machinable to any required dimensions, make for prompt direct action and utmost expedition.

One such example was given by a master mechanic who told how on the Sherman tank program he solved the problem of bearing maintenance with oil cushion cored and bar stock. His equipment was special, quite heavy, and bristling with anti-friction bearings. If through neglect, accident, or other reasons, such a bearing failed he could not quickly obtain replacements because many of these were special or of rare size. To keep the wheels turning he made temporary repairs with cored and bar stock. To his amazement, and our gratification, this maintenance job executed in an emergency and designed to be temporary in nature proved to be a highly desirable permanent installation.

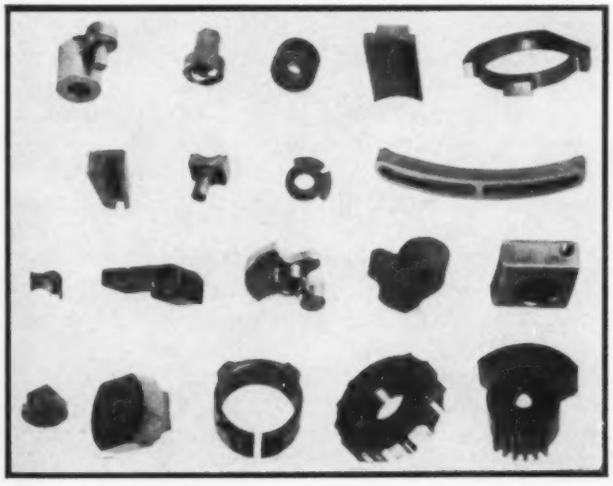
So far we have been referring only to self-lubricating bronze bearings. There are, of course, applications with unit stresses beyond the capacity of any bronze bearing. For this duty, we developed in the early thirties bearings made of powdered iron, powdered iron and copper, and other alloys. These were required primarily for applications of low velocity, but with unit pressures ranging from twenty thousand, forty thousand and sixty thousand pounds per square inch. Subsequently, duties of a higher order were encountered, and we produced bearings, again for low velocity applications, but capable of good performance under unit pressures as high as one hundred thousand pounds per square inch.

For technical reasons, and to save weight, aluminum self-lubricating bearings were developed. However, so far there has been no practical demand for them in production quantities.

Obviously machine parts, too, made from metal powders offer analogous advantages, but this paper is restricted to bearings only.

In conclusion, bearings of thousands of different sizes are available from production tools. New tools require but a short tool up period, and are relatively inexpensive. For small quantity requirements, and engineering development work, cored and bar stock is available. Specifications have been developed for self-lubricating bearings, and many tough problems have been solved by oil cushion bearings.

A series of irregular, ferrous, and non-ferrous machine parts.



DISCUSSION

PRESENTED BY

JOSEPH A. MARLAND, District Representative, W. A. Jones Foundry and Machine Company, Chicago, Illinois

ROBERT A. KRAUS, Lubrication Engineer, Republic Steel Corporation, South Chicago, Illinois

T. R. MOXLEY, General Master Mechanic, Wheeling Steel Corporation, Steubenville, Ohio

C. E. PRITCHARD, Lubrication Engineer, Republic Steel Corporation, Cleveland, Ohio

J. W. Marland: Mr. Langhammer mentioned some very interesting things. I would like to ask about bearings with a normal pressure of 40 or 50 pounds per square inch. What velocity do you find it necessary to observe with bearings that should have at least a thousand hours of life?

A. J. Langhammer: We reduce that to a pressure velocity factor and the normal value is 50,000. That serves the purpose very well for the normal heavy duty

application, but does not go into severe and extreme duties. Now, for applications of service of the higher order, we can improve that figure in bronze through processing and if forced oil feed is supplied.

J. W. Marland: In other words, you limit that velocity to about a thousand feet per minute.

A. J. Langhammer: Yes, that is correct, for a load of 50 pounds psi. However, as stated, greater velocities and pressures are permissible.

R. A. Kraus: You mentioned the filtering ability of your bearing when oil is added through the oil hole, and you also mentioned the ability of this type bearing to reabsorb its oil from the journal after operation. Now take the case where the dirt enters the bearing between the journal and bearing surface. Upon reabsorbtion of the oil, as you mentioned, isn't that dirt carried directly to the bearing surface and filtered out on this surface. Wouldn't this be highly detrimental inasmuch as this dirt lodged in the minute holes would act as a lap in subsequent operation?

A. J. Langhammer: What we did was to drill an oil hole through the housing to the back of the bearing (but not into or through the bearing wall) and filled the oil hole full of oil mixed with dirt and powdered emery. The foreign matter and abrasive did no harm as only clean, filtered oil worked through to the journal. Under conditions of heavy dust and dirt the foreign matter does not work into the bearing.

R. A. Kraus: You will admit that dirt can enter through the journal in other ways than through the oil hole, and you also mentioned that the oil is reabsorbed into the bearing after the bearing has stopped. In other words, the oil flows back into the porous material. In doing so, it would filter out this dirt directly into the bearing surface where it wouldn't be wanted. Your filtering principle is obviously working against you in this case.

A. J. Langhammer: You are basing your thoughts on a number of erroneous assumptions. It doesn't work that way. It works the other way around.

I will get off the subject for a moment. I imagine most of your people drive Chrysler cars, and the 1946 models have one feature common to no other automobile. This is a porous metal product which is a gasoline filter in the gas tank. We are filtering the gasoline in the tank, thereby giving you clean gasoline throughout the lines as well as the carburetor.

In our business, we experience many interesting results. There are a lot of characteristics which we find difficult to explain. We have certain railroad applications consisting of a plain bearing and journal. Those bearings are self-lubricating and no subsequent oil is provided. They are down underneath the cars, subjected to dirt, water and abrasives from the road bed. These bearings are in the brake mechanism of passenger cars and passenger equipment. The wear characteristic of the normal hardened and ground steel bearing and the hardened and ground steel journal is that at 200,000 miles, replacement of both units is necessary. However, with the Oilite bearing, both the bearing and the journal are still in good condition, not only after 200,000 miles, but after 400,000 and 600,000 miles. We have some with a total mileage of 800,000. Among the conditions we find with self-lubricating bearings is that the journal never rusts. On the contrary, it is highly polished and not scored. It has a mirror like surface, whereas with the normal material the pin is worn to a camshaft shape, and is also badly rusted, and pitted. Here we have an application that is constantly exposed to dust, weather, dirt, grit and abrasives, yet none of this foreign matter enters the bearing. We, of course, provide no safeguard for the bearing.

R. A. Kraus: The comparison that you have just made with the brake linkage pin was between a bearing operating under boundary lubrication conditions in the presence of an abrasive and a bearing operating without lubrication in the presence of abrasives. My original question concerned comparative performance of porous and non-porous bearings under lubricated conditions in the presence of abrasives which is obviously not the same situation. I would like to inquire whether after considerable service these porous type bearings glaze over and if so how does this affect the oil feed?

A. J. Langhammer: We don't have glazed surfaces. The bearing surfaces are porous, and remain so, meanwhile exuding oil during operating conditions.

R. A. Krause: In service, don't these bearings glaze?

A. J. Langhammer: We have run bearings a billion revolutions, and have both used and sold them for many years and never experienced a complaint. With oil present and no scoring, there is no glazing.

R. A. Kraus: In other words, you are saying that it doesn't glaze?

A. J. Langhammer: That is correct.

T. R. Moxley: Having used some of this bearing metal for quite some time, I have one question. At what temperature is it safe to operate a bearing using your metal, and how long could a bearing run at high temperatures without possibly evaporating that source of supply which we consider the lubricant of the bearing.

A. J. Langhammer: That is a very interesting question. In fact, it is a series of questions. The temperature at which you may operate a bearing successfully, depends upon the properties of the oil with which it is impregnated. The oil always fails before the material. You know, gentlemen, there are all kinds of oils, greases, and lubricants.

T. R. Moxley: About what is the safe operating temperature assuming that you know what you might call the flash point of the oil you use in the manufacture of the bearing? How high can you run them without danger to the bearing?

A. J. Langhammer: The flash point of the oils we use is of the order of 400 F, and we wouldn't like to see you go beyond 300 or 325 F, or that order. However, there are high temperature oils and lubricants available which we apply for the higher zones. The oil we use in our everyday standard bearing is a special oil, purchased at a considerable price penalty because of its outstanding quality, the principal feature being the non-gumming property.

T. R. Moxley: Would you recommend your bearing for an installation where you cannot use any oil at all?

A. J. Langhammer: That would depend on your load and velocity.

T. R. Moxley: The load is not heavy.

A. J. Langhammer: Then, you may use it with success. We have many applications that are never oiled subsequently.

C. E. Pritchard: I am a little confused about the reapplication of the lubricant. Is it or is it not to be considered, and if so, how do you tell when it should be reapplied?

A. J. Langhammer: There are many applications where no further lubricant is required, for example, the clutch pilot bearings in automobiles. Others are in railroad equipment, household equipment, textile machinery, farm implements, etc. We have no objections to providing for subsequent lubrication on any design, and so recommend if it is an application of high velocity and constant speed. Let us take an automobile water pump, which operates between 3000 and 7000 rpm. You must have added lubrication if this mechanism is to operate successfully over a long period of time.

C. E. Pritchard: How do you know when you are supposed to reapply it? How do you know you are not beyond the limitation?

A. J. Langhammer: I would like to refer to a specific application. Take the automobile water pump. There we use grease and not oil. We don't like grease. We know grease is not a lubricant in the sense that an oil is. However, water is present and water and oil do mix. However, certain greases do not mix and are not soluble in water. Therefore, a chamber is provided around the Oilite bearing which is filled with grease and we ask that more be added periodically, or about every three months. On other applications, the period is two weeks. However, on any application where subsequent oilings are necessary, oil cushion bearings provide a high factor of safety. Let's say, you would normally oil a bronze bearing once a day. Well, using a self-lubricating bearing, you may forget or neglect the lubrication of that particular bearing for thirty days, sixty days and perhaps longer without harm. If subsequent lubrication is normally provided, by all means arrange for it, but you have an invaluable factor of safety when it is neglected for a long period of time.

If we took this housing, undercut the bore, and filled the space between the housing and bearing outside diameter with oil, that oil would be sufficient to last the life of the equipment, on many applications. The reason is very little oil is required to lubricate a bearing. I think a drop of oil is reputedly good for seventy-five square inches, at room temperature. So very little is required, none is wasted, all is metered, and it will last a long time.

C. E. Pritchard: I guess, like all lubrication engineers, I don't want to use any more oil than is necessary for satisfactory service operation, but how am I as a lubrication engineer to tell from the service when oil is needed except by waiting for it to squeak, or do you have precalculated services?

A. J. Langhammer: I am a mechanic and served an apprenticeship as a toolmaker. In those days they told us to oil our lathes, shapers and planers once a day, which we didn't do. Some people think the modern mechanic has made progress along those lines. If you ask him to oil once a day, you may get it every second week or so. But, if you tell us your application, state the size of the shaft, the load, duty and rpm, the answer is easy. Take one of our case histories where a ¾ in. shaft fitted with a self-lubricating bearing, and at a normal load and 1500 rpm ran a billion revolutions. Reduce that to running time, and it will give you an astonishing number of weeks, which may be used to establish the point where you have to lubricate further. That, too, is at full load. We all know that bearing finishes, particularly in these days of super finishing, have a lot to do with bearing and shaft life. However, we normally work with a shaft or journal that has been machined to normal dimensions and finish.

AISE

DISTRICT SECTION MEETINGS

BIRMINGHAM **FEBRUARY 24, 1947**

"Large Electronic Direct Current Motor Drives" by M. M. Morack, industrial engineering division of General Electric Company, Schenectady, N. Y.

District Secretary: M. J. Booth, Birmingham 7-4232

BUFFALO **FEBRUARY 11, 1947**

"Recent Rolling Mill Practices" — By James Bray, United Engineering and Foundry Company, Pittsburgh, Pennsylvania.

District Secretary: H. C. Lindberg, Cleveland 2800

CHICAGO **FEBRUARY 4, 1947**

"Developments in Combustion Control" — By W. F. Pray, Askania Regulator Company.

District Secretary: A. J. Whitcomb, Wabash 4950

DETROIT **FEBRUARY 11, 1947**

Slab and Billet Conditioning Symposium — Chairman, J. A. Shimmin, superintendent of maintenance, Rotary Electric Steel Company, Detroit, Michigan.

District Secretary: E. F. Weiss, Madison 6860

PHILADELPHIA **FEBRUARY 1, 1947**

"Metal Spray Practice in Steel Plants" — By A. E. Cichelli, lubrication engineer, Bethlehem Steel Company, Sparrows Point, Maryland.

District Secretary: L. O. Morrow, Spruce 6765

PITTSBURGH **FEBRUARY 10, 1947**

"Electric Welded Tubing" — By E. Allardt, Babcock and Wilcox Company, Alliance, Ohio.

District Secretary: J. S. Murray, Atlantic 2039

For additional information concerning meeting locations make contact with district section secretary.

Report of Activities of AISE STANDARDIZATION COMMITTEE - 1946

by F. W. Cramer

CHAIRMAN

AISE STANDARDIZATION COMMITTEE

▲ ON October 1, 1945, the AISE Standardization Committee met in Cleveland, to plan postwar research and standardization activities of the Association of Iron and Steel Engineers. At that time, a series of thirteen projects were selected for execution from a large number which had been recommended by the board of directors and board of advisors of the Association. These projects were subsequently approved by the board of directors. One existing project was under way, so the authorization covered a total of fourteen projects. The projects are of four types: standards, of which there are seven; procedures, of which there are two; handbooks, of which there are two; and research projects of which there are three. In addition, another project on standards for steel mill lighting, on which the Association had agreed to cooperate with the Illuminating Engineering Society before the war, and which was postponed during the emergency, is now being revived by the I.E.S. Recently, because of new developments, mill motor standards have been again taken up for review by the committee.

Projects are handled in the following manner. Each project is assigned to a sub-committee headed, in general, by a member of the standardization committee. Each sub-committee chairman then selects the committee members for his project. In selecting the committee we attempt to form as large a representative group from the steel industry and, if pertinent, from the equipment supplier industry, as will make a workable committee. In general, the headquarters staff of the Association handles correspondence and any other work which the committee chairmen desire.

The procedure of the committee will vary, of course, with the nature of the project. Usually, the work consists of supplying and correlating data, offering advice (particularly in the case of research projects), and making final recommendations on adoption of standards to the main standardization committee, which standards are then approved by the board of directors at which time they become final.

All research work which is done and standards which are adopted will be made available to the membership of the AISE through the publications of the Association. It will be very desirable, whenever possible, to have the membership adopt the AISE standards, since industry-wide use of the standards will attain the maximum economy to be derived, both from the standpoint of the steel producer and also that of the equipment supplier.

During the past year, our standardization and research work has been a great deal more extensive than ever before in the history of the organization and a great deal of progress is to be reported. This progress is due chiefly to the cooperation of our members, and the companies for whom they work. Two of the projects which were initiated last year are now practically complete. Other projects are well along, and then again, there are some on which developments have shown that perhaps there is no reasonable solution to the problem. The following reports by the chairmen responsible for the various projects will give their progress on their various projects, and cover the period, in general, up to November, 1946. If any readers have any comments, criticisms or suggestions on any particular project, it is requested that they be mailed to the headquarters of the Association of Iron and Steel Engineers, 1010 Empire Building, Pittsburgh 22, Pennsylvania.

Presented before AISE Annual Convention, Cleveland, Ohio, October 1, 1946

DESIGN OF LADLE HOOKS

By PROFESSOR C. W. MUHLENBRUCH,

Carnegie Institute of Technology

▲OUR oldest research project is called "Crane Ladle Hook Investigation." At the completion of the crane girder test program at Lehigh University, the question of designing hot metal ladle crane hooks was suggested as a likely continuation of the investigation. This project was referred to Professor Thomas of the Carnegie Institute of Technology, but war research prevented him from devoting his time to the project, so in September, 1945, it was turned over to Professor Muhlenbruch at Carnegie for completion. Test speci-

TABLE I — Riveted Joint Test Results

Specimen number	Type of rivet	Type of loading	Working stress, psi	Average slip at working stress, in.	Average slip at 150 per cent of working stress, in.
1	A141-39, hot driven	Static	28,800	0.00021	0.00047
2	A141-39, hot driven	Static	28,800	0.00011	0.00027
3	A141-39, hot driven	Static	28,800	0.00016	0.00031
Average				0.00016	0.00035
4	A141-39, hot driven	Repeated	28,800	0.00039	0.00063
5	A141-39, hot driven	Repeated	28,800	0.00017	0.00035
6	A141-39, hot driven	Repeated	28,800	0.00031	0.00053
Average				0.00029	0.00050
7	A141-39, hot driven and welded	Static	48,000	0.00033	0.00078
8	A141-39, hot driven and welded	Static	48,000	0.00018	0.00062
9	A141-39, hot driven and welded	Static	48,000	0.00023	0.00057
Average				0.00025	0.00066
10	A141-39, hot driven	Repeated	48,000	0.00031	0.00067
11	A141-39, hot driven	Repeated	48,000	0.00032	0.00062
12	A141-39, hot driven	Repeated	48,000	0.00024	0.00041
Average				0.00029	0.00057
13	A195-39, hot driven	Static	37,800	0.00034	0.00082
14	A195-39, hot driven	Static	37,800	0.00034	0.00118
15	A195-39, hot driven	Static	37,800	0.00038	0.00063
Average				0.00035	0.00088
16	A195-39, hot driven	Repeated	37,800	0.00044	0.00058
17	A195-39, hot driven	Repeated	37,800	0.00047	0.00059
18	A195-39, hot driven	Repeated	37,800	0.00022	0.00048
Average				0.00038	0.00055
19	A195-39, hot driven and welded	Static	57,600	0.00049	0.00100
20	A195-39, hot driven and welded	Static	57,600	0.00039	0.00080
21	A195-39, hot driven and welded	Static	57,600	0.00045	0.00103
Average				0.00044	0.00094
22	A195-39, hot driven and welded	Repeated	57,600	0.00016	0.00041
23	A195-39, hot driven and welded	Repeated	57,600	0.00032	0.00060
24	A195-39, hot driven and welded	Repeated	57,600	0.00025	0.00056
Average				0.00034	0.00052
25	A141-39, cold driven	Static	.....	.....	.....
26	A141-39, cold driven	Static	.....	.....	.....
27	A141-39, cold driven	Static	.....	.....	.....
Average				.....	.....
31	A141-39, cold driven and welded	Static	.....	.....	.....
32	A141-39, cold driven and welded	Static	.....	.....	.....
33	A141-39, cold driven and welded	Static	.....	.....	.....
Average				.....	.....
34	A141-39, cold driven and welded	Repeated	.....	.....	.....
35	A141-39, cold driven and welded	Repeated	.....	.....	.....
36	A141-39, cold driven and welded	Repeated	.....	.....	.....
Average				.....	.....
37	None, welded only	Static	19,200	0.00033	0.00060
38	None, welded only	Static	19,200	0.00030	0.00053
39	None, welded only	Static	19,200	0.00020	0.00038
Average				0.00028	0.00050
40	None, welded only	Repeated	19,200	0.00023	0.00037
41	None, welded only	Repeated	19,200	0.00023	0.00043
42	None, welded only	Repeated	19,200	0.00035	0.00036
Average				0.00027	0.00039
43	A141-39, hot driven	.....	.....	.....	.....
44	A195-39, hot driven	.....	.....	.....	.....
45	A141-39, cold driven	.....	.....	.....	.....
Average				.....	.....

Test results not yet available, where spaces are blank.

mens became available in April of this year and testing has continued since that time.

The first of the four phases of this investigation had as its object "to study the joint action of various types of rivets, and the advisability of combining riveting with edge welding." With the exception of the cold-driven riveted joints, all specimens included in this phase of the project have been subjected to static load, and load-slip observations made for the entire loading range. Tests have been made using a compression type of specimen and have included rivets made of A.S.T.M. A141-39 and A.S.T.M. A195-39 steels as well as both of these rivet types combined with edge welding. Static tests have also been made of specimens which were edge welded but not riveted. All rivets of the previous alloys were hot-driven, and cold-driven joints are now in the process of being tested. Slip observations, made along all four of the mating surfaces for three specimens of each type, show that edge welding considerably reduces the slip of the plates of a riveted joint. The general tendency for the combination of riveting and welding is to permit a working load equal to the sum of the ordinary working loads due individually to riveting and welding. At this increased working load, the slip may be from 15 to 65 per cent more than the slip observed at the working load of a joint which is only riveted. Since this increased slip occurs for loads of from 50 to 67 per cent more than the rivet load alone, the addition of the edge welding seems to be justified.

The second object of the investigation was "to investigate the effect of repeated loading on joints riveted in various ways, and with riveting combined with edge welding." Tests have been made on the A141-39 rivets both alone and when combined with edge welding. Repeated loading tests have also been made of specimens which were edge welded but not riveted. It has been found that a total load which sets up the permissible unit stress in the rivets and which is repeated only 300 times may increase the slip an average of 82 per cent for hot driven A141-39 rivets, an average of 16 per cent for the same rivets with edge welding and nothing for specimens which are welded but not riveted. Since failure of a joint occurs rapidly after first slip, this is considered to be a most important observation. This great increase in the slip following such a few repetitions of load is due to the fact that hot-driven rivets lose most of their ability to resist slip after their initial grip has been overcome.

The third object of the investigation was "to study the effect of heat applied to one side of a ladle-hook shank as regards the magnitude and distribution of temperatures and stresses on the various component plates making up the shank of the hook." Preliminary theoretical investigation of this aspect of the work indicates that it will be the most important consideration in the entire project. As soon as the repeated loading tests have been completed, a "dummy" length ladle-hook shank will be subjected to temperature tests to determine the distribution and magnitude of the stresses and to thus guide the theoretical analysis.

The fourth and final object of the ladle-hook investigation was "to make field tests of new ladle-hooks fabricated according to two different designs, and also one old ladle-hook which has had a reasonable amount of service." This work has not been done pending permission to make field tests of stresses in an existing ladle-hook and also to enlist the cooperation of a fabricator so that observations can be made on completely new ladle-hooks.

Test results now available are given in Table I.

DESIGN OF HOT METAL LADLES

BY F. E. KLING, *Steel Works Engineer*

▲ OUR second research project now underway is, "Design of Hot Metal Ladles." This project was set up in the hope that lighter and perhaps stronger ladles can be obtained, if a scientific testing program could be applied to the problem. Inasmuch as little work has ever been done on the subject, it was felt that this would be a particularly fertile field.

Purpose of project — The theories of computing stresses in pressure vessels, bridges and other structures have been definitely established. The stresses in a ladle are highly indeterminate due to the shape and method of assembly. Since ladles carrying liquid metal cannot be allowed to collapse, the tendency has been to play safe in designing the same. This results in additional weight, requiring a crane of larger capacity than would otherwise be necessary.

The only way to arrive at theories and accurate design formulae is through research and experiments. More accurate knowledge on actual ladle behavior should result in lighter and better ladles.

Progress of project — The committee consists of: F. E. Kling, steel works engineer, Youngstown, Ohio; R. B. Gerhardt, chief engineer, Bethlehem Steel Company, Bethlehem, Pennsylvania; Leonard Larsen, chief engineer, Cleveland District, Republic Steel Corporation, Cleveland, Ohio; Harry McFeaters, chief engineer, Pennsylvania Engineering Works, New Castle, Pennsylvania; F. L. Lindemuth, chief engineer, Wm. B. Pollock Company, Youngstown, Ohio; W. W. Wallace, district sales manager, M. H. Treadwell Company, Inc., Pittsburgh, Pennsylvania; I. E. Madsen, Association of Iron and Steel Engineers.

Two meetings have been held, one on December 6, 1945, and the other one on August 20, 1946. It was decided to give the assignment of research and experimenting to the Fritz Engineering Laboratory of the Lehigh University, Bethlehem, Pennsylvania in charge of Professor B. G. Johnston, and Mr. W. H. Munse.

Three models are to be made, one of riveted and two of welded design. The capacity will be about 1½ tons, the size ratio about one to five for diameter and height of ladle. The models will consist of the frustrum of a cone with a side slope of one inch per foot and a depth of molten metal the same as the average diameter. Other models will consist of the frustrum of a cone in which are inserted two pieces of flat, one on each side, comparable to a prototype having thirty inches of flat. All of the models will be based on a prototype of 150-ton capacity.

The loading medium is to be mercury, and in some cases water or a heavier liquid like sodium silicate, or

liquids used in mineral separation. One test may be made with hot metal.

Measurements — There are various items of the ladle which may be considered in designing for strength. They are: the trunion pin, trunion assembly, stiffening rings, the side walls of the shell, and the bottom of the shell. Measurement will, therefore, be made in an attempt to determine what strains exist in each of these members when the model ladle is loaded, and also whether these strains are comparable with those obtained by theoretical consideration. Those measurements which at this time appear advisable, to obtain the desired information, are as follows:

1. Change in shape of the ladle at the top and each stiffener ring by use of dial gages.
2. Strains in the side walls of the shell by use of SR4 electrical strain gages.
3. Strains in the stiffening rings by use of SR4 gages.
4. Strains in the trunion assembly by use of SR4 gages.
5. Strains in the bottom of the shell by use of SR4 gages.
6. Deflections of the bottom of the ladle by use of dial gages.

CHAINS AND SLINGS

BY J. B. MITCHELL and J. F. BYERS

Jones and Laughlin Steel Corporation

▲ THE subject of chains and slings was for a long time one of the projects on which it was difficult to make much progress. A number of the chain companies were requested to give information on their standards, and recommendations for standards, to serve as a basis for an AISE standard. Of the replies which were received, two manufacturers submitted information, and five others referred us to The Chain Institute, the trade organization of the industry, for information. The Chain Institute informed us that they are working on a similar project for the American Society for Metals, "Metals Handbook."

In the middle of October, 1946, we received a final corrected draft from the Chain Institute, and the material incorporated in it gives much of the information required for the AISE standards. However, further information is required to satisfy all the needs of the operating men in the steel industry, and this information is being requested again from the chain manufacturers.

SIZE AND TYPE OF SHUNTING FOR MOTOR BRUSHES

BY H. B. CONOVER,

Carnegie-Illinois Steel Corporation

▲ ONE of the AISE's most ambitious standardization projects is called, "Size (Length, Width, and Breadth) and Type of Shunting for Motor Brushes." This project was initiated because some steel companies as well as individual steel plants have found that plant and company standardization of brushes has greatly reduced brush costs. The advantages include quantity discounts, smaller inventories, and apparently longer wear. Such standardization on an industry-wide basis could only result in greater overall economies. In our initial objective, the work is limited to motor brushes for motors of one horsepower and up. Standardization is based on NEMA and American Standards Association brush standards, and in this respect is essentially a simplification program, since the brush industry is working to these standards.

The work is handled as follows:

1. Collection of lists of brush sizes used by different steel plants. Information includes quantity of brushes to be used. When such lists are not available, motor lists are used, and brush requirements determined from the motor lists.
2. Correlation of various plant brush lists into one overall list. Most widely used brushes will then be selected as standards.
3. Carbon brush committee will then approve tentative standard and make any additions or subtractions which are deemed necessary.
4. Recommended list will then be sent to motor manufacturers and brush users for criticisms and comment.
5. Upon reception of these comments, committee will make final recommendation on standards.

At the present time, a number of plants have been requested to submit brush information, and data has been obtained from four companies. Summaries are being made on the information which has been received. Information is still expected from four companies or plants, and it is hoped that this will be soon available. The committee is also being formed now and will consist of eight men, five of whom have already accepted, and three more are yet to be heard from.

SURFACE FINISH

BY H. B. CONOVER

Carnegie-Illinois Steel Corporation

▲ PREVIOUS to the adoption of our proposed method of designating the surface finish desired in measurable terms, considerable difficulty and expense was incurred finishing various surfaces on machinery parts either with too fine a finish or too rough a finish. In the case of too fine a finish, unnecessary time had been spent obtaining this too smooth surface which increased the cost. In the case of too rough a finish, it was necessary to return the part, pay the added expense and, in many cases, lose time which was more valuable. Tests have shown that the cost ratio between a finish of average 4 to an average of 2000 micro-inches is 40 to 1. This indicates that savings are available by the selection of the proper finish.

Drawings in most cases carried finish marks on those surfaces to be finished. This mark was the customary "f" designating finish. The degree of finish was usually left to the shop as they were supposed to know the finish required and they did know generally where work for their own plant was concerned. Trouble, however, started with the war when every shop was

performing work for plants other than their own plant.

In addition to the "f" mark, certain drawings carried additional designations that were defined as "polished," "rough," "ground," or "smooth." This also caused confusion when the job went to a shop that was not familiar with the customary interpretation of these words. The question was then, how rough, how smooth? As these terms and designations are not measurable, they have no meaning, except by local custom, and it became apparent that some system of designating the required surface finish must be adopted or devised that could be designated in measurable terms.

Inquiries were instituted during the early part of 1941 to learn what others had done toward adopting a system of measurable surface finishes. These inquiries included standards associations, manufacturers of

TABLE II — Classification of Machined Surface Finishes

Symbol	Class	Roughness micro-inches		Suitable for tolerances of plus or minus unless otherwise specified, in.	Definition of finish	Typical method of producing finish (does not include all methods)	Approximate relative cost to produce
		Average	Average peak to valley				
* ▽A	Super finish	4	15	0.0005	Mirror like surface without tool, grinding or file marks of any kind.	Ground, micro-honed, lapped, burnished, buffed, to best surface possible.	40
* ▽B	Polish	8	28	0.0005	Smooth finish with very close tolerance limits and without scratches.	Ground, honed, lapped, burnished, etc.	35
* ▽C	Ground	16	56	0.001	Smooth finish with close tolerance limits.	Ground, rolled, filed, lapped, etc.	25
* ▽D	Smooth	32	118	0.002	Bearing surface where accuracy is essential and tool marks objectionable.	Square nose tool with drag feeds to suit. Ground, rolled, filed, milled, etc.	18
* ▽E	Fine	63	220	0.003	Smooth surface without objectionable tool marks; moderately close tolerance.	Shaped, milled, ground, reamed, rolled, broached, etc.	13
* ▽F	Semi-fine	125	455	0.004	Surface requiring good finished appearance or where fairly close dimensional accuracy is essential.	Shaped, ground, broached, milled, etc.	9
* ▽G	Medium	250	875	0.007	Where good surface is essential, such as machined parts, etc.	Shaped, rough ground, milled, turned, bored, drilled, spot-faced, etc.	6
* ▽H	Semi-rough	500	1750	0.013	Where close tolerance is not required for parts that fit together in bolted or riveted assembly, when uniform bearing area is needed.	Shaped, rough ground, milled, turned, bored, etc.	4
* ▽J	Rough	1000	3500	0.025	Rough surface produced by removing stock to nominal dimension.	Round nose tool, $\frac{3}{64}$ to $\frac{1}{4}$ in. feed.	2
* ▽K	Clean up	2000	7000	0.050	Very rough surface produced by removing excess stock to approximate size for clearance or appearance.	Round nose tool, $\frac{1}{32}$ to $\frac{3}{8}$ in. feed.	1

*Refers to General Electric standard roughness specimens.
Method and procedure of obtaining the various required finishes may vary according to size, shape, design, or contour of the work.
Comparisons are generally made by sight and feel methods.
Regardless of the material or method of processing used on the finished product, each specimen represents the roughest surface acceptable for each symbol.
In general, average values were determined by a Profilometer, and "average peak to valley" values, by a brush surface analyzer or a profile recorder.

equipment, and purchasers of equipment. While certain associations and manufacturers were then working on systems of surface finishes or were using something on this order in their own shops, we found no national standard or anything that covered the range required in a steel plant, from the very fine finishes required for precision equipment to the very rough finish which is sufficient where metal is removed for clearance.

Sample blocks of the finishes required were then made and measured. After this was completed, the problem of how to duplicate these blocks, exactly, in large numbers, so that samples could be furnished all shops, seemed to be difficult to solve. Before a reasonable solution was found, the General Electric Company brought out their present handy box of samples and their tables of roughness measurements. As their range and steps correspond almost exactly with those we had decided were needed for a steel plant, we adopted their samples and standards, and they are in satisfactory use throughout my company.

The adoption of a system of standards for surface finish does not mean that all existing drawings need be revised to the extent of placing the correct symbol on all surfaces. New drawings should be correctly symbolized but existing ones may be symbolized where definite symbols are required.

The advantages to be secured by the adoption of a national or at least an industry-wide system for surface finishes and their designations, we believe, are obvious. According to the system we are using, a "d" finish means it shall not be rougher than an average of 32 and a peak to valley of 118 micro-inches. This is definite and measurable. There are 10 finishes listed which cover all requirements.

The American Standards Association have proposed standards for surface roughness, waviness and lay. They propose 30 roughness standards as compared to the 10 General Electric standards. This large number of standards is, of course, necessary to cover all industries as a national standard should. For steel plants, we have found no reason for more than the 10 now in use. Seven of these 10 match with seven of the American Standards Association. One differs by 5 and another differs by 3 micro-inches. The tenth standard is 2000 micro-inches and the roughest standard of the A.S.A is 1000 micro-inches.

The proposed "Standards for Surface Finishes," is tabulated in Table II.

CONTENT AND AMOUNT OF DIRT IN STEEL MILL ATMOSPHERES

▲ THE third research project was initiated because of the lack of information on dirt and soot in steel mill atmospheres. Such information is essential for proper design of air-cleaning and air-conditioning systems around the steel plant. Not much information is available on the subject, and some of what is available has already been collected by the Association. The American Society of Heating and Ventilating Engineers has been contacted, but they have apparently done no work on this particular subject, although there is a possibility that they may do some in the future.

TURBINE INSPECTION

BY H. W. NEBLETT,

Inland Steel Company

▲ IT has been proposed that a standard should be established covering the interval of time between steam turbine inspections. The first step in determining this time was soliciting data from the turbine builders, several steel plant maintenance and operating departments, and the Edison Electric Institute, the latter pertaining to public utilities only.

The information received shows a wide variation between the various individuals and groups as to the interval between inspections, this variation being from a minimum of 9000 hours to a maximum of 35,000 hours.

In the case of a new turbo generator being put in service, its first inspection would be at the end of the period covered by the manufacturer's guarantee.

It is generally agreed that external inspection tests should be conducted regularly. These inspection tests should cover vibration, steam consumption, and steam pressure drop in the various stages at a given load. Vibration indicates loss of blades or other unbalance. A change in pressure drop between stages indicates obstruction in steam passage due to dirt accumulation or other causes. If no trouble is indicated by the periodic external inspection test, the unit should operate until the regular number of hours between internal inspections have been reached.

Data so far received indicate, for steel mill service, the interval for turbo generator internal inspection to be 20,000 hours or approximately two years. For turbo blowers, the interval is 9000 hours or one year. For smaller turbines, such as those used for driving pumps, gas boosters, fans, etc., no internal inspection is indicated from the data received. For this type of equipment, the period of operation is determined by the regularly conducted external inspection, and when these inspection tests indicate any abnormal operating condition, an internal inspection of the unit is made.

This report covers the findings to date of the subcommittee on turbine inspection. This committee solicits and would appreciate further comments from operating, maintenance and other interested members of the Association of Iron and Steel Engineers.

INSPECTION PRACTICES FOR MAINTENANCE OF MILL BUILDINGS

BY L. F. COFFIN,

Bethlehem Steel Company

▲ WE have received to date a sketchy outline of inspection practices in several mills. We are accumulating slowly this information but need more assistance from members in the different plants so that we may get a better cross-section of prevailing practices.

It is our endeavor to explore the possibilities of developing a standard recommended procedure for in-

spection and repair practices in the maintenance of mill buildings and structure.

What we need additional information on is: how inspections are made, who makes them, what is looked for while inspections are being made, what use is made of inspection reports, what general method is used for prosecuting the work after authorization, and over what period of the year is the work spread? Information on novel and interesting inspection and repair methods is solicited.

FUEL, FURNACE, CERAMICS, AND CONTROL ENGINEERS' HANDBOOK

BY A. J. FISHER,

Bethlehem Steel Company

▲ THE board of directors of the Association of Iron and Steel Engineers at their meeting in Cleveland on September 30, 1946, expressed their desire to combine the already authorized "Steel Mill Data Book" and the "Fuel, Furnace, Ceramics, and Control Engineers Handbook." The work is to cover steel making on a departmental basis; namely, coke ovens, blast furnaces, open hearth and bessemer, blooming and slabbing mills, bar and billet mills, etc.

The board expressed the desire to compile these books in a thorough manner that would reflect credit on the Association and referred their desires to the Standardization Committee for action. An outline for the book is now being studied.

HANDBOOK OF LUBRICATION STANDARDS FOR THE STEEL INDUSTRY

BY C. E. PRITCHARD,

Republic Steel Corporation

▲ OUR second handbook project is called "Handbook of Lubrication Standards for the Steel Industry." The purpose of the development of a lubrication handbook is to assist in design, operation, and maintenance throughout the steel producing industries, and also to form a guide for those members who are entering into the various phases of the steel industry with the thought that they might be better prepared to do their work with a higher degree of perfection.

The first meeting of the lubrication handbook committee was held on May 31, 1946 in Pittsburgh. The committee members consist of C. E. Pritchard, chairman, Eric Anderson, C. R. Hand, T. R. Moxley, H. F. McEntire, A. W. Gittens, T. J. Ess and I. E. Madsen. It is noted from the above listing that the selection of the committee members was made to include a representative of the electrical, mechanical, engineering, operating, and lubrication phase of the steel industry in order to insure complete coverage.

A tentative outline has been prepared which includes the aims, purposes, and coverage of a handbook. Chapters 1 to 5 inclusive cover in their respective order, an explanation and description of fundamentals of organic chemistry, various types of crudes and methods of refinement, manufacture of greases and their suggested usage by type, and description and charts of various processing oils and their selection. They also include type of equipment and method used for testing lubricants, selection of proper lubricants, and method for applying same for specific applications. Type, selection, and design of bearings, bearing materials, bearing seals, gears, and recommended practices for preventing bearing failures and preparation of mating parts, reclamation of oils, etc., are proposed chapter sub-headings.

Chapters 6 through 10 include a complete coverage of the lubrication practices broken down in the various departmental subdivisions of a steel plant such as blast furnace and coke plants, steel producing units, rolling mills and steel plant auxiliaries.

It has also been suggested that a section be devoted to covering methods of inspection and recording of inspection data. The various committee members were asked to secure all the available charts and publications that they might have access to, and forward same to the AISE headquarters to act as a reference library. The headquarters of the Association are in turn to obtain information and other pertinent data from the various suppliers and steel producing plants that might assist in making the handbook more complete.

A decision on obtaining a librarian to review abstracts as well as someone to review tables, charts, etc., and also the decision as to the size and format of the handbook were to be left with headquarters of the AISE.

PLAIN BEARINGS

BY C. E. PRITCHARD,

Republic Steel Corporation

▲ THE committee for this project is composed of C. E. Pritchard, chairman, W. E. Hyde, and H. L. Smith. No formal meeting of the above committee has been held to date. A questionnaire has been prepared and issued to various representatives of the steel and bearing suppliers to obtain their best recommended practice for plain bearing applications.

A review has been made regarding the standardization of plain bearings by various other industries, and contact has been made with the automotive industry and the electric motor manufacturing industry.

The purpose of the above-mentioned project is to provide a common ground whereby the best operating practice can be instituted wherever plain bearings are involved, and some definite reasons set down for the selection of the type and tolerances to be used. Thus, it has as its object the standardization of bearings and bearing tolerances for various mill applications. The project may develop into a research project if laboratory work is found necessary.

The committee members are to secure all publications and information that they have access to and forward same to headquarters of the AISE for a reference library. They will also review and catalogue the answers received to the questionnaire mentioned above, and expect finally to present to the industry, a proposal for a standardization practice covering plain bearing applications.

SIZE OF SAFETY SWITCH

BY ERIC L. ANDERSON

Bethlehem Steel Company

▲ THE object of this project is to standardize the mounting dimensions of safety switches so that the switches of various manufacturers will be interchangeable. In setting up a standardization program for safety switches, there appeared several fundamental requirements that should be the basis of the project. These are as follows:

1. Switches to be standardized should range up to and including 2 pole and 3 pole, 200 ampere. The use of switches larger than 200 ampere is somewhat limited and in most cases circuit breakers are more desirable.
2. Switches of similar ratings should be physically interchangeable as to space requirements and mounting dimensions, regardless of the manufacturer. Location and size of knockouts should be standardized.
3. The number of different size enclosures should be kept to a minimum. This means that several different switch ratings would use the same size enclosure.
4. The standards should not be of such nature that they would limit the manufacturer to a definite design of operating mechanism or use of specified materials. They should provide only for interchangeability of an entire switch regardless of make.
5. Since most steel mills require that the switch be of the knife blade type, so that on opening the door, the blades may be readily checked for the open position, only Type A switches should be considered.

In order to secure the reaction from various operating men, the following proposal was forwarded to several of the large steel companies for their comments. Practically every reply was to the effect that such a program was desired.

This proposal covered the use of six size enclosures for the entire line of switches from 30 ampere, 2 pole, 230 volts, to 200 ampere, 3 pole, 575 volts.

The size of the enclosures and the size switch each enclosure was to house was proposed as follows:

Enclosure No. 1 — 11 in. × 15 in.
- 30 amp, 250 v, 2 pole fusible and non-fusible.
- 30 amp, 250 v, 3 pole fusible and non-fusible.
- 60 amp, 250 v, 2 pole fusible and non-fusible.
- 60 amp, 250 v, 3 pole fusible and non-fusible.

Enclosure No. 2 — 13 in. × 28 in.
- 100 amp, 250 v, 2 pole fusible and non-fusible.
- 200 amp, 250 v, 2 pole fusible and non-fusible.

Enclosure No. 3 — 16½ in. × 28 in.
- 100 amp, 250 v, 3 pole fusible and non-fusible.
- 200 amp, 250 v, 3 pole fusible and non-fusible.

Enclosure No. 4 — 11 in. × 17 in.
- 30 amp, 575 v, 2 pole fusible and non-fusible.
- 30 amp, 575 v, 3 pole fusible and non-fusible.
- 60 amp, 575 v, 2 pole fusible and non-fusible.
- 60 amp, 575 v, 3 pole fusible and non-fusible.

Enclosure No. 5 — 13 in. × 29 in.
- 100 amp, 575 v, 2 pole fusible and non-fusible.
- 200 amp, 575 v, 2 pole fusible and non-fusible.

Enclosure No. 6 — 16½ in. × 29 in.
- 100 amp, 575 v, 3 pole fusible and non-fusible.
- 200 amp, 575 v, 3 pole fusible and non-fusible.

In the above case, the width includes space for operating handle on switches having handle mounted on the outside of the enclosure.

Following the favorable reaction to the proposed standards as listed above, a committee was appointed to consider the problem and to work out necessary details. This committee consists of an equal number of representatives from the steel industry and from the various safety switch manufacturers. At a recent meeting of this committee, the discussion brought out several points for consideration.

It was thought that the proposed standards required that too large an enclosure was being recommended for the 30 ampere, 2 pole switch. Since the trend of 3 phase power supply in the steel mill is the use of 440 volts instead of 220 volts a-c, the necessity of including the 220 volt 3 pole switches in the standardization program was questioned. An alternate proposal was made to standardize only the 250 volt, 2 pole switches, and 575 volt, 3 pole switches. All switches would be of the fusible type, and if a non-fusible switch was required, a copper bar could be used in place of the fuse. If a two pole, 575 volt switch was required, a 3 pole switch would be used. When 220 volt, 3 pole switches are required, those available of present design would be used.

Such an arrangement would reduce the number of enclosures to four, and set up the following as a standard:

Enclosure No. 1
- 30 amp, 250 volt, 2 pole.

Enclosure No. 2
- 60 amp, 250 volt, 2 pole.
- 30 amp, 575 volt, 3 pole.
- 60 amp, 575 volt, 3 pole.

Enclosure No. 3
- 100 amp, 250 volt, 2 pole.
- 100 amp, 575 volt, 3 pole.

Enclosure No. 4
- 200 amp, 250 volt, 2 pole.
- 200 amp, 575 volt, 3 pole.

It was thought that standards should only apply to switches in Class I enclosures for indoor installation. Outdoor switches are more or less special installations and are not too numerous.

All switches must meet Underwriter's requirements.

The question of knockouts was discussed, and one suggestion was to omit knockouts entirely as it was usually at this part of the case where rusting and deterioration started.

NEMA has indicated an interest and a willingness to cooperate in the problem of safety switch standardization and a meeting of both committees will be scheduled in the near future.

The economics of such a program will have to be developed, especially if the proposed standards would require a special line of steel mill safety switches.

This committee welcomes any suggestions or criticisms pertaining to the problem of the standardization of safety switches and would appreciate comments on the proposal to standardize only 250 volt, 2 pole switches, and 575 volt, 3 pole switches in sizes from 30 to 200 ampere in four sizes of enclosures.

FLEXIBLE AND SOLID COUPLINGS

BY FRANK W. CRAMER,

Carnegie-Illinois Steel Corporation

▲ ABOUT a year ago, we were able to standardize on plain couplings for shafting to be included in the AISE Specifications for Heavy Duty Mill Type Cranes. It seemed desirable to extend this work to cover a wider range and also to include flexible couplings.

After consultation with several coupling engineers, information and recommendations were requested from 18 coupling manufacturers, as to which coupling was recommended for each of the mill motor sizes, as well as detail prints of the couplings. Nine manufacturers have sent us the requested information so far, and these include the ones of most vital concern to the steel industry.

It will be much more difficult to set standard dimensions for flexible couplings than for solid couplings due to the differences in design between the various manufacturers, although it is hoped that we will be able to standardize design enough to make them interchangeable.

Work at the present time is now being held up until we know definitely what form the new mill motor standards will take if they are revised. The reason for this is that the same shaft size may have to transmit a higher horsepower, and, in this event, the data which we now have may not apply.

WIRING DIAGRAM AND CONTROL SCHEMES

BY WILLIAM B. FERGUSON

Carnegie-Illinois Steel Corporation

▲ THIS project, now close to completion, is called, "Wiring Diagrams and Control Schemes," and is under the jurisdiction of a combined AISE - NEMA committee, the AISE section of which is now headed by W. B. Ferguson, of the Carnegie-Illinois Steel Corporation, and the NEMA section is headed by P. B. Harwood of the Cutler-Hammer Company. The work of this committee is an extension of the work of the old AISE Control Committee which has been inactive since about 1934. It was thought advisable to limit the first phase of the job to standardization of wiring diagrams. Later on, we plan to see if we can set standards on d-c mill magnetic control, and d-c magnetic brakes, although no work yet has been done on these topics.

The following standards for wiring diagrams for steel mill controllers are presently proposed by the committee:

Scope — The following rules apply to diagrams for all control designed especially for steel mill service. This includes main and auxiliary mill drives, processing lines, cranes, etc. They do not apply to catalog controllers (such as line starters) used in steel mills.

Sizes — The following sizes are standard, and agree with ASA-Z14.1:

1. 8½ in. × 11 in.
2. 11 in. × 17 in.
3. 17 in. × 22 in.
4. 22 in. × 34 in.

For diagrams requiring more space, use multiple sheets of 22 in. × 34 in. size, with match lines.

Content of Diagram — The wiring diagram shall include:

1. Panel internal connections:
   Rear view of wiring shall be shown when the principal wiring and external connections are to be made on the rear of the panel. Front connected panels shall be shown by a front view. When there are connections to both front and rear, the major wiring shall determine the view, and the minor wiring shall be indicated as being on the opposite side of the panel. All control wires are to be numbered, and machine connections identified in accordance with ASA-C6. Mechanical interlocking between devices is to be indicated. If notes are used to explain the interlocking, the indication must be shown in addition. The internal panel connections may be shown by lines, or the so-called "wireless" method may be used.
2. Panel external connections:
   All external connections shall be shown and the wires numbered, and the machine connections identified in accordance with ASA-C6.
3. Elementary diagram:
   All control wires shall be numbered.
   Mechanical interlocking of devices may be covered by notes without using dotted lines.
   The ohms and continuous watt capacity of control circuit resistors shall be shown. They may be included in list of contactors and relays (7).
   The voltage and capacity of capacitors shall be shown, and may be included in list of contactors and relays (7).
   If it is not practical to show ohms, watts, voltage, capacity, etc., on the elementary diagrams, the information shall be included in an instruction book, with spare part data.
   Where practical, the elementary diagram shall be located in the lower right corner of the wiring diagram, and confined to a space 8½ × 11 in., which space will include the title block, and items 5 and 7. This permits clipping the elementary for separate filing. If more space is required, confine the elementary to the right hand side of the diagram above the title block. If the elementary diagram requires a separate sheet, its number shall be cross indexed with that of the wiring diagram.
4. Master controller sequence chart:
   Where master controllers are shown in accordance with ASA-Z32.3, the diagram of the master automatically becomes a sequence chart.
5. Contactor sequence chart:
   This chart should show the contactors which are closed in each position of the master controller, and indicate those which may or may not be closed as determined by the operation of automatic devices.

If the chart is too complicated to be shown on the diagram, it may be included as a part of the operating instructions.

A sequence chart is not required for single speed (pushbutton) controllers.

6. Identifying information:

Diagrams, including those shipped with the controller, must be identified by including on them the following information:

A. Manufacturers order number.
B. Ultimate user's name (if obtainable).
C. Ultimate user's order number, (if obtainable).
D. Drive identification.
E. Cross reference to the resistor diagram.

When a diagram is made specifically for a certain drive, and there is little chance of it being used for another order, the identifying information may be placed on the tracing above the title block.

When the diagram is more or less standard, and will probably be used for other orders, the identifying information should appear on the back of the blueprints, or be typed on a sticker pasted to the blueprints. Still another method is to leave a blank space on the tracing and fill it in on the prints.

7. Functional list of contactors and relays. Example 1F-2F, forward direction contactors. 1A-2A-3A, armature accelerating contactors.

General:

Symbols should agree with ASA-Z32.3.

Device markings should agree with NEMA-1C51-10.

Machine markings should agree with ASA C6.1.

Abbreviations should agree with ASA-Z32.13.

The name plate on the control panel shall include the number of the diagram, or diagrams.

All wire terminations (studs and lead holes) on the rear of the control panel are to be numbered to correspond with the diagram. The manufacturer's number of all coils and devices, and the operating voltage, will be supplied as spare parts data.

Resistor diagrams — Resistor construction diagrams are to include:

1. Ohms of each step.
2. Continuous amperes capacity of each step.
3. NEMA class number.
4. Identifying information as covered by (6) above.

Definitions:

1. *Schematic diagram* — A schematic diagram is an illustrative diagram whose principal purpose is to show the operating principle of a device or group of devices without necessarily showing actual connections or circuits. Schematic diagrams may use pictures or symbols to illustrate or represent devices or their elements. (They are applicable chiefly to instruction books, descriptive folders, or other mediums whose purpose is to explain or instruct.)
2. *One-line diagram* — A one-line diagram is one which indicates by means of single lines and simplified symbols, the course and component devices or parts of an electric circuit or system of circuits. (One-line diagrams are useful in showing the over-all relations between component devices of circuits and between circuits, such as for power circuits and switch gear.)
3. *Elementary diagrams* — An elementary diagram is one which shows all circuits and device elements of an equipment and its associated apparatus, or any clearly defined functional portion thereof. Such a diagram emphasizes the device elements of a circuit as distinguished from the physical arrangements of the conductors, devices, or device elements of a circuit system. (Elementary diagrams are useful where electrical relationships of circuits and device elements are the principal considerations).
4. *Connection diagrams* — A connection diagram is one which shows the connections of an installation or its component devices and equipment. They may cover internal or external connections or both, and contain such detail as needed to make or trace the connections that are involved.
5. *Construction diagram* — A construction diagram is a diagram whose purpose is to show features of construction specifications in simplified form. (A construction diagram is useful to show the stacking of resistor grids, rectifier discs, etc.)

PROPOSED REVISIONS TO AISE CRANE SPECIFICATIONS

BY I. E. MADSEN, *AISE*

▲ THE Association of Iron and Steel Engineers Specifications for Electric Overhead Cranes for Steel Mill Service were completely modernized and brought up to date early in 1942, and were published in the August 1942 *Iron and Steel Engineer*. This revised crane specification is now out of print and before reissuing it, it has been deemed advisable to bring it up to date and to incorporate some changes and suggestions which the use of the previous specifications indicate to be desirable. When these specifications were published in 1942, criticisms of the specifications were invited, with the idea of making any changes which these criticisms might require.

The last revision of the crane specifications incorporated very major changes in the structural strength and design requirements, and most of these changes were based on the previous research work which the Association of Iron and Steel Engineers had done at the Fritz Engineering Laboratory of Lehigh University. Few structural revisions are proposed for the new specifications, and changes which are proposed are essentially minor changes in wording for clarity. However, major changes are proposed for the gear and motor selection clauses. The crane committee has not met to approve or disapprove the proposed changes since full information on these changes is not yet available.

This report covers the proposed changes in three sections:

1. Structural.
2. Mechanical.
3. Electrical.

STRUCTURAL CHANGES

The most important structural change will be the elimination of clause 17 E 40 which limits the ratio of the depth of the box of the girder to the width of the

box to 3.5. The other changes in the structural specifications are minor changes in wording.

CHANGES IN MECHANICAL DETAILS

The present clause for the pitch diameter of the drum is now set as not less than thirty times the diameter of the hoisting rope. It is proposed to limit this to thirty times the diameter of the hoisting rope when 6 × 37 wire rope is used and to increase the diameter to not less than 45 when 6 × 19 rope is used. It is also proposed to eliminate the ½ in. size diameter hoisting rope.

The standard design for crane track wheels which was published in November, 1943 in the *Iron and Steel Engineer* and the AISE Standard for Crane Sheave Wheels which was published in the August, 1944 *Iron and Steel Engineer* are being inserted in the new crane specifications.

It is also proposed to add to Table I of the Crane Specifications, a new crane rail size of 135.86 lb per yard. This rail is a new section which has been recently developed and which will fit in the present large gap in rail sizes between the 105 lb crane rail and the 175 lb crane rail.

The AISE Standard Design for Crane Shaft Couplings which was published in the September, 1945 *Iron and Steel Engineer*, is also included in the revised specifications.

The clause on press fits and keys is revised to be in accord with the ASA specifications.

A clause is being added that requires safety dynamic braking which will provide automatic braking upon power failure, if so specified on the information sheets.

Another clause is being added stating that centralized lubrication systems will be used if specified on the information sheets.

Table G, which is the tabulation of roller bearings, will be slightly revised to include bearings which were not previously available and to add another manufacturer.

Major changes are expected in the gearing specifications. These specifications were criticized by the American Gear Manufacturers Association. Some of the gearing clauses which were previously used and some of the tolerances used in the previous crane specifications are not in accordance with AGMA recommendations. In addition, AGMA has approved, although not yet published, two basic standards for determining the sizes of gears, the first of which is based on the beam strength of the gear, and which is a modification of the Lewis formula, and the other is a new wear design formula. Both of these AGMA standards will be published in the near future. Upon receipt of the various criticisms from the AGMA, we asked them for their recommendations and they set up a committee to prepare recommendations for a suggested set of specications for crane gears which will be in accordance with the standard practices and specifications of the gear industry, as well as their latest data on the subject. We have been working with this gear committee on this revision. Tables have been computed which will be included in the specifications.

The new AISE gear specifications are set up on the basis of various hardness combinations. This arrangement will allow the user to select case hardened, oil, water and brine quenched, flame hardened, and untreated gears, and rating varies with hardness of gear and pinion.

ELECTRICAL DETAILS

The specification clause on electrical controls is being modified so that either manual or magnetic control will be used on trolley motors whose crane rating is below 20 hp, as specified on the information sheets.

Minor changes are also made on the hoist limit switch. Among these changes, it is proposed to allow a hoist limit switch consisting of a counterweight directly connected with the limit switch and guided by suitable guides which act on the hoist cables. This latter design will be optional at the discretion of the purchaser.

It is proposed to allow the use of "no fuse" air circuit breakers for disconnect switches for use on crane auxiliary circuits such as crane lights, etc.

There has been a good bit of criticism on the formulae for motor selection for cranes. It is proposed that hoist motor selections be based on a clause similar to the following:

$E = 0.93^n \times 0.98^m$ for sleeve bearing cranes.

$E = 0.95^n \times 0.99^m$ for roller bearing cranes.

where n = number of pairs of gears and

m = number of sheaves passed over by each rope attached to the drum.

E = efficiency.

The present clause states that efficiency will be taken to be 75 to 80 per cent.

Due to the very varied types of service which different cranes must undergo, it is extremely difficult to set the sizes for bridge and trolley drive motors by means of a formula. These motors should be selected by the root-mean-square method when the duty cycle is known, and this clause will be included in the specifications. Unfortunately most crane duty cycles are not known, and persent formulae may in some cases give cranes which are over motored and in other cases give cranes whose motors overheat readily. One of the reasons for this is the fact that the gear ratio is not always properly selected, and this again is dependent on the fact that gear selection has been based on the specified crane speed. Several plants have found recently that changing the gear ratio to provide better acceleration has eliminated heating problems, and permitted the crane to perform various duty cycles in a shorter time. As a matter of fact, a smaller frame will often give less heating for the same duty if the gearing is properly designed. Most present crane motor specifications use a formula which determines the hp required to move the crane at a specified top speed. A motor is then selected whose crane rating is two to three times the specified speed. Then, unless the gear ratio is selected to correspond with the speed of the motor at the torque required to overcome friction drag alone at top speed, and unless the friction drag is not actually less than that assumed in the calculations, the actual bridge top speed will be greater than that specified. On the other hand, the acceleration load is much greater than usually realized, and this load is not normally taken into account in the bridge drive calculations. For example, if the

controller is designed to give an acceleration of only 0.6 ft per second squared, the acceleration load is three times the running load, and if the controllers were set at an acceleration load of two feet per second squared, the acceleration load will be nine times the running load. This is the factor which causes bridge motor overheating, particularly, when cranes must start and stop frequently. Ordinarily, it is rather an unusual cycle on which the bridge motor is used much at full load speed with no acceleration load, since this can only occur where a crane moves up and down a very long runway.

Therefore, it is proposed to modify the bridge drive specification clauses so as to take into account the following factors:

1. Class of service such as severe, average, moderate and light.
2. Acceleration must be taken into account in motor selection, and desired acceleration must be specified by crane purchaser just as he now specifies the required bridge speed.
3. If possible to include in the specification, some provision will be established to set allowable watts loss.

The above changes which have been suggested can be incorporated in the specifications without too much difficulty with the exception, perhaps, that further study of the bridge drive clauses may change some of the proposed bridge motor specifications.

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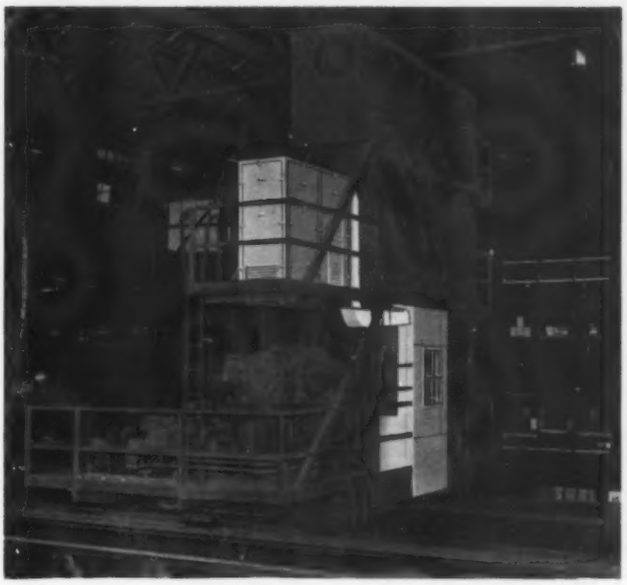

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Electrical Control

FOR THE NEW 56 IN. CONTINUOUS HOT STRIP MILL, THE STEEL COMPANY OF CANADA, LTD.

. . . . setting forth some applications of rotating regulators in the controls of a modern strip mill . . . .

by D. C. McCrady and W. J. Shortall

CANADIAN GENERAL ELECTRIC COMPANY, LTD.

▲ THIS paper is intended to supplement the paper "New 56 in. Continuous Hot Strip Mill, The Steel Company of Canada, Limited" by C. J. Porter, published in the December 1946, *Iron and Steel Engineer* and to describe in some detail how the basic requirements of the various Ward Leonard drives have been met by the rather extensive use of the amplidyne machine. This rotating regulator control is the principal feature of the electrical drives in which the new mill differs from many existing installations of conventional design.

POWER FACTOR CONTROL OF MAIN MILL MOTOR GENERATOR SETS

Beginning at the a-c power supply end of the mill, the amount of reactive kva supplied by the 9800 hp synchronous motors (driving the main mill motor generator sets) is governed by means of an amplidyne regulator to hold constant power factor on the incoming lines to the whole station (comprising the reversing plate mill, hot strip mill, and ultimate cold mill). Alternatively, the synchronous motor exciter may be controlled manually by means of a rheostat in the amplidyne circuit, to maintain any value of synchronous motor field desired, within the safe limits imposed by field heating and pull out torque.

The fields of the motors may be supplied from the constant 250 volt d-c bus (general purpose exciter or shop supply as desired) by means of a throwover switch, see Figure 1. A conventional motor-operated rheostat is furnished for each motor, to control the field when this 250 volt source is used. Synchronizing is always performed with weak field (contact "d" open).

Normally, however, the fields are supplied from a conventional shunt wound exciter, whose field is split into two parts. The main portion is connected to the 250 volt supply through a suitable resistor. Contacts "ab" are closed normally, and the exciter operates at less than 250 volts. The exciter main field is capable of supplying sufficient ampere turns to produce this normal average exciter voltage.

A "manual-automatic" transfer switch is provided on the duplex board. In the "manual" position, the exciter voltage may be varied by means of a small rheostat, contacts "b" and "bc" being closed (as well as "ab"). Part of the exciter voltage 1-2 is compared with the reference voltage 3-2, the difference voltage circulating current in the amplidyne field F5F6 in the proper direction tending to correct the difference. The amplidyne thus applies voltage to the exciter auxiliary field to bring the exciter voltage up or down to the proper value. The manual rheostat is proportioned to allow variation of the exciter voltage over the permissible synchronous motor field range.

In the "automatic" position, two other fields of the amplidyne are connected through small rectifiers to the a-c network shown. For power factor control, the variac (variable auto-transformer) is set at the mid position, so that with no load current flowing in the lines, equal and opposite voltages are applied to the amplidyne fields, from the potential transformers, phase shifter, and variac. If load current is flowing, a voltage appears across resistor A, from the current transformers, and is added vectorially to the original rectified a-c voltages applied to the amplidyne fields. If the phase shifter is turned so that voltage XY is at right angles vectorially

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to the voltage produced across resistor A, when the load current is at, say, 90 per cent power factor lagging, then the two amplidyne fields will again be balanced. If the phase shifter (a small selsyn whose rotor can be clamped in any rotational position) is left in this position, and the station load increases, tending to lower the power factor, the two voltages will no longer be at right angles to one another, and one amplidyne field strength will predominate, thereby changing the excitation and correcting the power factor back to nearly 90 per cent for the new load condition. It can readily be seen that by leaving the phase shifter in the unity power position, the setting of the variac itself can be varied, thereby causing the regulator to hold a definite value of reactive kva, instead of constant power factor.

Two rectifiers are used in conjunction with field F5F6 to provide an upper and lower limit on the exciter voltage, this field tending to strongly oppose F1F2 or F3F4 if the latter attempt to produce too great or too little synchronous motor field excitation.

During starting of either motor generator set, contacts "c" and "bc" close, thereby raising the exciter voltage to 250 volts, until synchronizing is accomplished, after which the manual or automatic control is brought into operation by opening of contacts "c" and "bc" and closing of contact "ab," and also "a" or "b" (depending on whether automatic or manual control is desired). Two hundred fifty volts are required for starting and synchronizing, so that the motor operated rheostat resistance is effective in setting the proper field currents, regardless of whether the shop supply or the normal exciter is used for the source of field power.

The simplicity of the regulator is apparent from the diagram, there being no moving parts. The devices are all of the small panel mounted variety, and once the resistor taps are adjusted, the only maintenance consists of the usual periodic renewal of brushes on the amplidyne and exciter.

MAIN MILL STAND DRIVES

Power for the six mill motors is obtained from four generators, all operating on a common bus, and each rated 3500 kw at 600 volts. A single conventional shunt wound exciter provides power for the fields of all the generators. In the case of exciter failure, the exciter normally used for the synchronous motors could be used, with the synchronous motor fields connected temporarily to the constant 250 volt supply, as explained previously.

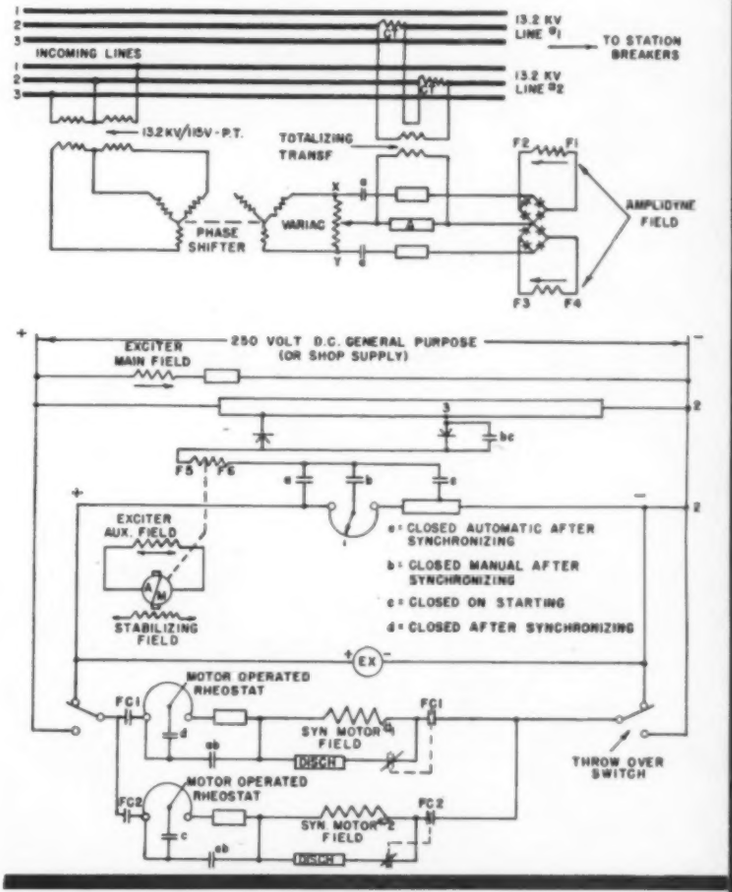
The principal requirement of the mill drives is the maintenance of as nearly constant speed under the varying load conditions as possible. This really means constant bus voltage, since the large mill motors have inherently an almost flat speed-load characteristic. The operator must, of course, be able to set up the individual stand motor speeds by motor field control at the values required by the rolling of strip, but once these settings are made, the speeds should be maintained. This is of particular importance on the last stand, since any variation in its speed will be transferred to the flying shear only after the inherent time delay in the machines driving and controlling the shear. Consequently, any sudden change in the last stand speed will cause an uneven length of cut on one or two pieces of sheared strip, until the shear motor speed becomes readjusted to match that of the last stand once more.

The difference between stand speeds is accomplished by means of motor-operated stand motor field rheostats, controlled from switches located in the speed pulpit, as well as by vernier "stick" controls, the latter including about 15 per cent of the overall 2 to 1 speed range by motor field control.

The overall speed or bus voltage is controlled by an amplidyne exciter, supplying power to the main generator exciter mentioned previously. One field of the amplidyne is connected directly to the exciter itself, through a suitable resistor, so that the exciter is able to supply most of the excitation required for the amplidyne and hence for itself. In effect, the exciter is thus self-excited at a little less than the rated full voltage full load value required by the main generator fields. A second, or regulating, amplidyne field is excited by the difference between an adjustable reference voltage and the bus voltage. At rated 600 volts on the bus, this field swings from slightly bucking to slightly boosting, when the generators are loaded from no load to full load. Thus, only a few volts drop from the 600 are required to make this change, and close regulation is achieved.

Referring to Figure 2, a motor operated rheostat controlled by the master switch in the speed pulpit is

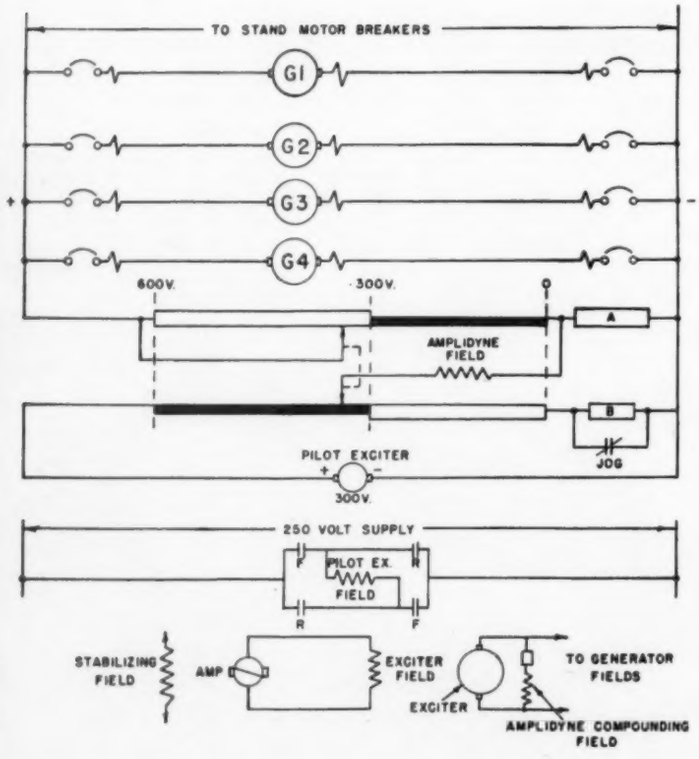
Figure 1 — The synchronous motor control has among its features the ability to hold constant power factor, and it can also be adjusted to hold a definite value of reactive kva.



equipped with two dials, each dial consisting of a variable resistance over half its range, and a solid conducting bar over the other half. One dial is connected across the main bus in series with a fixed resistance A, equal in ohmic value to the total resistance part of the dial. The second dial is connected to a constant voltage pilot exciter whose field may be reversed for jogging purposes. Over the range from zero to 300 volts, the amplidyne is controlled by changing the proportion of the pilot voltage used as a reference. Over the range from 300 to 600 volts, the full pilot voltage is used as a reference, and the proportion of the bus voltage used for comparison purposes is varied by cutting the resistance of the first dial gradually into circuit. When jogging, the rheostat must be in the extreme lower position, and then resistor B may be cut into the reference circuit, thereby producing a low fixed reference voltage for jogging purposes.

A "jog-run" switch is also provided at the speed pulpit. In the "jog" position, the rheostat is held at the lower extreme, and jogging may be accomplished by means of a "jog forward-job reverse" switch, which operates as described, to jog whichever motors are connected to the bus. In the "run" position, the rheostat automatically moves to a position slightly above zero, to provide a bus voltage which will just turn the stands over at a creeping speed continuously. This is necessary to equalize the roll pressures when the roll balances are in operation, and the use of the "jog-run" switch assures that the required low speed is obtained even when the operator turns his master switch to the "off" position, ordinarily tending to lower the bus voltage to zero.

Figure 2 — Main generator control for six-stand mill drive.



Two types of emergency stopping are provided. The operator may trip the generator circuit breaker switch, thereby disconnecting all generators from the bus, but allowing the motors to coast to a standstill by friction. The operator may, on the other hand, trip the "emergency" switch, which disconnects both motors and generators from the bus, and allows the motors to stop rapidly by dynamic braking. Permissive switches are, of course, provided on the duplex board in the motor room, so that when absolutely necessary, the motor room operator may trip any generator or motor from the line.

A wide variety of protective features is provided. As it is undesirable to shut down a continuous strip mill with hot metal in the rolls, selective systems are incorporated. An alarm is actuated for any adverse operating condition which, however, may be permitted to continue for a short time. This includes ground on the 600 volt bus, overheated bearings, or continuing overload. For any of these difficulties, the mill operator may, at his discretion, either complete the particular strip, or he may continue rolling at some reduced rate until furnaces are clear. Loss of motor field, overspeed of mill motor, short circuit in any armature, overvoltage on the main bus, or overspeed of the main motor generator sets will all cause shutdown of the machines involved.

Short circuit protection is built into each main circuit breaker, tripping being actuated by the rate of rise of the current. Thus, a fault is detected immediately it occurs, and is promptly removed.

SCALE BREAKER PINCH ROLL DRIVE

The scale breaker, being driven only by a 75 hp motor, requires only that its speed must follow the speed of the first stand, and hold the strip reasonably taut between its rolls and those of the mill. A fine speed matching arrangement is not practical, since any change in draft taken on the stand would affect the speed relationship required. Consequently, a coarse speed control is used, along with a load control on the scale breaker motor. This is practical, since any change in load on the small scale breaker motor will be reflected as roll-to-strip friction, and will not affect the speed of the vastly larger stand motor. Thus, if the scale breaker load drops off for some reason, the speed is slightly increased to pick up the load again and slacken off on the friction. To start up the drive, the operator merely turns his master switch to "run," and sets the speed approximately by means of a small rheostat at the pulpit, and the scale breaker will maintain the same speed relationship compared to the mill stand, over a fairly wide actual strip or stand speed range. It is consequently unnecessary for the operator to touch the controls while rolling, except when a change in draft is

made, and the coarse speed matching rheostat must be roughly readjusted. With the master switch in the "job" position, jogging forward or reverse may be accomplished at a low fixed speed by means of a separate jogging switch.

Referring to Figure 3, the main shunt wound generator supplying power to the scale breaker motor has its field directly supplied from an amplidyne exciter. The motor field is excited at a fixed value from the constant 250 volt supply. The tachometer generator geared to the first stand motor, employed for speed indication with a voltmeter in the pulpit, is here used as the reference source for the scale breaker speed control. A portion of its voltage as determined by the setting of the operator's speed rheostat, is compared with part of the generator voltage, and the difference voltage is applied to the amplidyne field. This part of the scheme is identical with that used for the main mill drives. However, it is necessary, as already explained, to produce a deliberate droop in the speed-torque (voltage-current) characteristic to prevent overloads on the drive. A small amount of resistance "A" in the armature circuit produces an IR drop proportional to load, and this voltage is allowed to pass current back through the circuit, opposing the reference tachometer generator voltage, by creating a voltage drop in resistor "B." A load control rheostat located in the speed pulpit is employed to vary the amount of feed back current used, and hence is capable of changing the speed-torque characteristic.

To protect the drive against heavy currents in the event of a heavy slab stalling the motor, a rectifier "C" short circuits the load control rheostat, provided the load current IR drop exceeds in value the reference voltage 1-2, obtained by the resistor connected to a small source of rectified a-c power. At lower values of load, the rectifier prevents current flow in the reverse direction. Both rectifiers "B" and "C" provide a current limit control when the drive is started or stopped, depending on which direction the load current flow through resistor "A" happens to be.

For jogging purposes, part of the rectified a-c voltage is used as a reference, positive or negative, depending on direction of rotation required, and this reference voltage produces a definite generator voltage or speed, just as the tachometer generator reference does during normal operation.

Notice that when the master switch is turned to the "off" position, the reference is disconnected, and part of the generator voltage is applied directly to the amplidyne field in a differential direction, and rapid neutralizing results, again under current limit control, since the load current feedback again flows through resistor "B," causing an IR drop to oppose the generator voltage, and thus controls the neutralizing action or rate of retardation of the drive.

By furnishing the electrical controls on the scale breaker as described, the speed operator has become relieved of one responsibility, since he is able to set the controls once, and then forget them until a radical change in draft on the first stand is made again. He is thus able to watch the stand controls more carefully than he would be able to, were it necessary to vary the scale breaker controls as well while rolling.

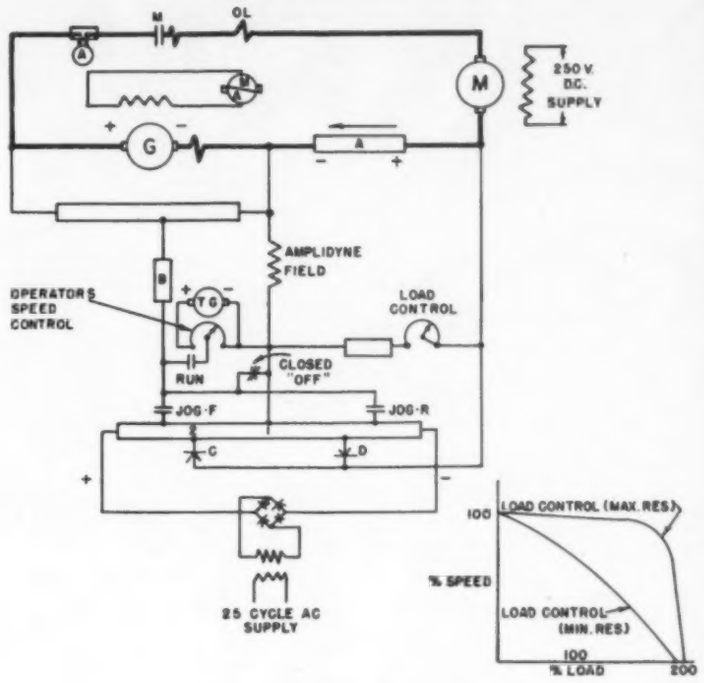


Figure 3 — The controls for the scale breaker drive relieve the operator of the responsibility for making adjustments during rolling until a radical change is made on the draft of the first stand.

LOOPERS

The arrangement of looper drives is perfectly conventional, shunt wound mill type motors being employed, and supplied from a low voltage d-c generator. Whenever a looper control switch is operated, full generator voltage is applied to the motor in order to produce the snappy action desired; after a couple of seconds delay, a resistor is connected in series with the motor armature, to reduce the continuous load to a safe value from the heating standpoint. There are provided motor field rheostats located in the pulpit, to adjust the motor torques to the required value.

Each looper may be operated manually, as described above, or the control switch may be turned to "automatic." In the latter case, the looper is operated whenever the load relays operate on the stands adjacent to the looper, or in other words, whenever the strip is in the rolls on both sides of the looper. The coil of each load relay is connected across the pole face winding and interpole field of the stand motor, and the relay is adjustable as to the value of load required to energize it.

FLYING HOT SHEAR DRIVE

Mechanically, the shear drive is quite conventional, consisting of the two knife drums geared together with a ratio of 6 to 5, so that a cut occurs every five revolutions of the bottom drum. Two 150 hp motors constitute the electrical drive. A multi-contact limit switch,

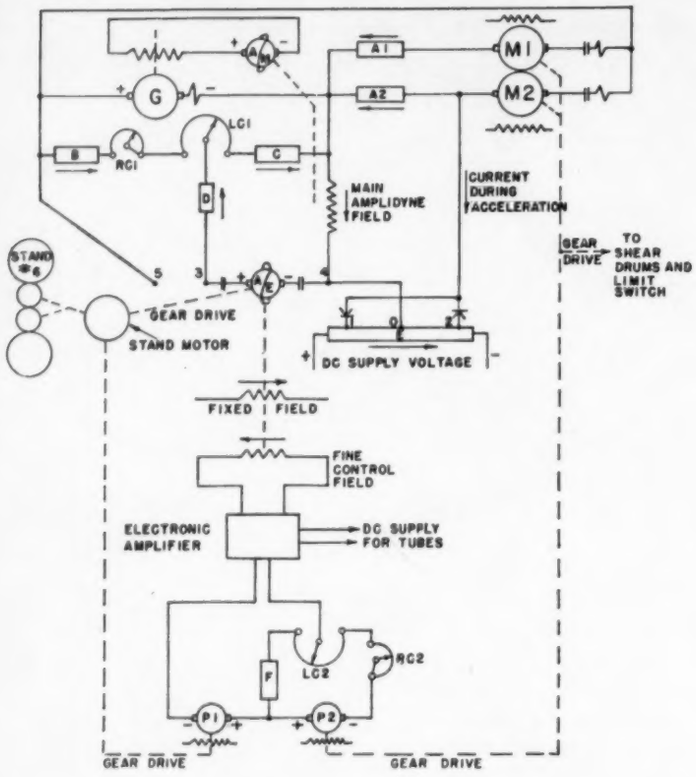


Figure 4 — The flying shear electric tie enables regulation of lengths of cut to better than ½ of one per cent.

geared to the drive, makes one complete revolution or cycle during each cut when one knife is used (½ revolution when two knives are used on the bottom drum). The usual front-end crop disposal equipment is included, consisting of a 15 hp motor-driven lower pinch roll and a motor-roller; power supply for the latter is obtained from an alternator, itself driven by the lower roll, thus maintaining approximate synchronism between the two rolls. A pneumatic reset mechanism is used, a solenoid valve being the initiating medium for raising and lowering the roller, itself operated by a contact on the shear limit switch, so that the roller is raised at the proper position relative to the point at which the first cut is made. The crop gate is push-button operated from the main pulpit (alternatively from the roller's pulpit). The shear itself may be started manually, in which case it operates continuously until stopped; or it may be operated automatically. In the latter case, one of the load relays (the same relays as are used for lopper operation) is arranged to initiate starting of the shear a certain time after the relay operates. The time may be varied by means of a rheostat in the main pulpit, and is so adjusted by the operator for a given strip speed and draft schedule, that the front end of the strip has just entered the shear the second time the knives come together after the shear starts or the fourth time, if there are two knives being used. It is just after this cut is made that the motor-roller is raised, thus preventing the following strip from being scratched by the higher speed pinch rolls. When the load relay is de-energized due to the tail end of the strip leaving that particular stand, another timing cycle initiates stopping of the shear after the last cut is made. The shear is made to stop, then reverse at a low speed, and finally come to a stop again at a definite angular position with the knives in a horizontal position, ready for the next cycle to begin.

It is evident that the principal requirements of the shear drive proper are first, that the shear be accelerated to full speed and stopped in the shortest possible time (hence the use of a 300 hp drive, when the running load is only about 50 hp); second, that the speed of the shear be maintained accurately, once it is set for a certain length of cut; third, that the speed of the shear be directly proportional to the last stand speed for any length-of-cut setting; fourth, that the length of cut be adjustable over a 2 to 1 range, and be adjustable to any definite value in feet by means of a rheostat; fifth, that compensation be available for changes in roll diameter of the last stand, another rheostat being adjusted to a definite position for any given roll diameter.

Referring to Figure 4, two control schemes are employed, one being a coarse speed tie between the last stand speed and the actual shear speed, and the other a fine speed tie which has a vernier action on the coarse speed control.

The two 150 hp shear motors, whose fields are excited at constant strength, are supplied by a single generator G. Small line resistors A, and A2 are used for load division between the motors. The generator field is supplied by an amplidyne exciter AM, whose field in turn is excited by the difference between part of the generator voltage, and a small amplidyne pilot generator AE voltage. Since this pilot generator is geared to the last stand, and its excitation is obtained from its fixed field, its voltage is therefore a measure of strip speed. The proportion of generator voltage chosen for comparison with the pilot generator voltage is determined by the length of cut rheostat setting LC1. A roll compensation rheostat RC1 also affects the voltage used. The coarse speed control thus consists of controlling the generator voltage, and hence the shear motor speed to make it proportional to the last stand speed, and at the same time make it adjustable for the length of cut required, and the diameter of roll on the stand. Resistor D has a value such that with either comparison voltage applied alone, about twenty times full voltage excitation will flow through the amplidyne field. Hence, inherent accuracy and strong forcing are realized. A current limit circuit is included for starting and stopping, employing one of the line resistors for measuring the load current, and a fixed reference voltage is applied to resistor E. During acceleration, the IR drop in resistor A2 exceeds the voltage 1-0, and current flows through AE and resistors D and C produced by this voltage difference. The IR drop in resistor D caused by this current, opposes most of the amplidyne tachometer AE voltage, thus reducing the current in the amplidyne field sufficiently to just provide the required accelerating current. The rectifiers prevent flow of current when the IR drop in resistor A2 does not exceed the reference voltage, that is, when the drive has reached a steady speed condition.

The fine control consists of varying the excitation of the pilot generator AE by means of an accurate speed

matching arrangement. A separate fixed excitation pilot generator P1 driven also by the last stand, is used as the fine control reference, its voltage being accurately proportional to the stand speed. A duplicate pilot generator P2 is geared to the shear itself, so that its voltage is proportional to the shear speed. A voltage divider consisting of a second dial on the length of cut and roll compensation rheostats, and a resistor "F," determines the proportion of the shear pilot voltage which is compared with the stand pilot voltage. The difference voltage is amplified in the electronic circuits, and the output of the amplifier is applied to a field on the coarse stand pilot generator AE. The fixed field of AE alone provides sufficient excitation to cause about 10 per cent overspeed of the shear, and the amplifier, being undirectional in action, only delivers current to the control field in a direction to oppose the fixed field, and thus lower the shear speed the required 10 per cent. If, for any reason, the electronic amplifier or fine pilot generators are cut out of circuit, the shear will merely run about 10 per cent faster than it should, and the regulation of lengths of cut will be of the order of 3 or 4 per cent instead of ½ of 1 per cent or less.

The electronic amplifier is a simple, two tube device, whose power supply is obtained from the control exciter. Its output does not need to be great, about 2 to 3 milliamperes, since it is supplying the field of an amplidyne rather than a standard pilot generator. This results in long tube life and dependability of the control.

When the shear is required to be stopped, the AE pilot generator is disconnected from points 3-4, and a fixed reverse voltage is applied instead between points 5-4. This causes stopping and reverse operation at a low speed, all under current limit control. Final stop is in turn accomplished by reversing this fixed reference voltage, opening the motor line contactors, and setting the shunt brakes. The fixed reference voltage (now applied in the forward direction) sets the open circuit generator voltage at a low value, so that when the line contactors are closed for the next start, and the full AE voltage is again substituted for the fixed reference, there will be no delay in obtaining sufficient main generator voltage to circulate maximum current in the motors for the required full accelerating torque.

Stabilizing circuits are employed (not shown) for overcoming any tendencies to shunt, these tendencies resulting from the very great overall amplifications used, the inherent time constants of the rather large machines, and of course the inertia of the drive itself.

Results obtained with this shear drive have been most satisfactory. The outcome has been that it is possible on many orders to use the flying shear to cut the actual shipping lengths with sufficient accuracy and consistency that no other trimming of the flats is necessary.

RUNOUT TABLE AND COILER DRIVES

The table and coiler motor arrangement is quite conventional. The first two table sections are supplied each by a 250 kw generator; the last two sections, alternatively the two coilers, are supplied each by a 125 kw generator. Group cabinets on the mill floor

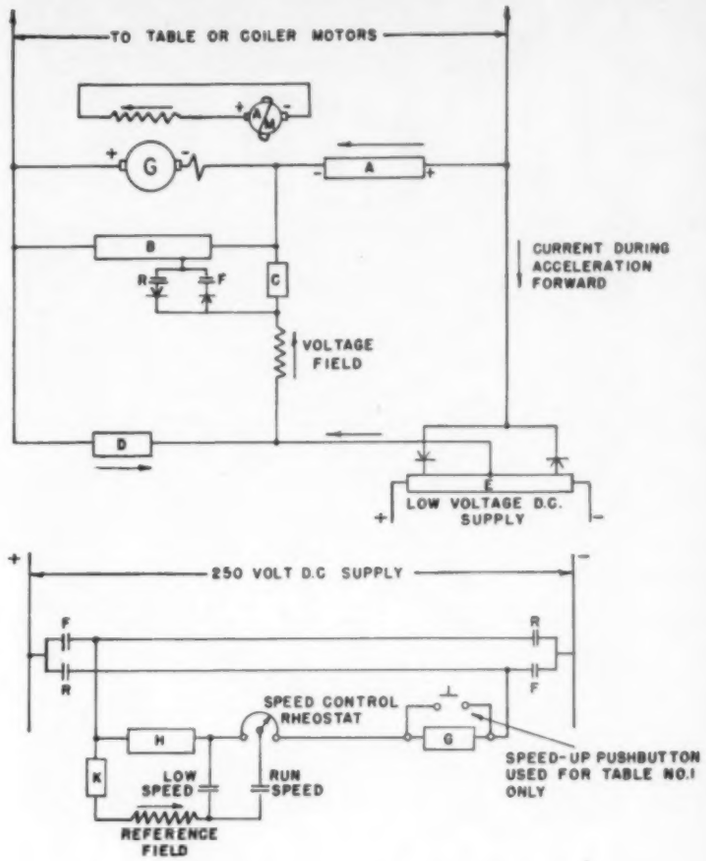


Figure 5 — Runout table and coiler regulator.

provide individual table and coiler motor protection. Each table section (or coiler) is controlled as a unit by controlling the generator voltage. The master switch in each case has four positions "low speed reverse, off low speed forward, running speed forward." The speed attained under the last master switch position is adjustable by means of a rheostat at the pulpit. Principal requirements of the drives are rapid acceleration and deceleration, reasonable speed regulation, and simplicity of control.

Figure 5 illustrates the control scheme for one of the four generators. The amplidyne exciter supplies the generator field. One field of the amplidyne is supplied by a potentiometer consisting of resistors G and H, and the speed control rheostat, connected to a source of d-c power, which may be reversed by means of directional relays operated by the master switch. The amount of excitation applied to this field depends on the speed setting, and will always be over ten times the amount required to actually produce the desired generator voltage or speed.

A second field is connected to oppose the reference field, and is supplied by the generator voltage itself, through resistors C and D. For any particular speed setting of the rheostat, the generator voltage will rise to a value such that the "voltage" field strength is just a little smaller than the "reference" field strength, the net difference being sufficient to excite the amplidyne to the required voltage. Since each of these fields is of

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the order of ten times the net value required, excellent voltage regulation is achieved.

During acceleration or retardation, the voltage field is further excited by the IR drop in the line resistor "A," opposed in turn by a fixed reference voltage applied to resistor E, thus providing current limit control. Blocking rectifiers are employed to prevent any current limiting effect when the load IR drop is less than the reference voltage.

If the control is "plugged," the reference field is reversed. Since the motors are still rotating in the forward direction, their counter voltage will circulate current in the reverse direction through resistor A and the generator, and the generator voltage must be held positive in polarity to limit this current, until the motors reach a standstill and the generator voltage reverses. Directional contacts are used, along with blocking rectifiers, to employ part of the generator voltage in assisting the IR drop voltage in resistor "A" to produce the necessary positive voltage field strength. If this were not done, the load IR drop would have to be much greater at the moment of plugging, which would mean dangerously high load currents in the motors from the point of view of commutation.

The table and coiler control thus meets the requirements of this type of drive, and yet is quite simple from the maintenance standpoint.

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DESIGN AND AIR-CONDITIONING OF A

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by Richard Darrah

DRAVO CORPORATION

PITTSBURGH, PENNSYLVANIA

▲ INDUSTRY has always been willing to accept the new, when that "new" has been designed and developed from sound engineering principles. Such was the case when the Ford Motor Company accepted the many new features embodied in the design of a new 250 ton stripper and extractor crane furnished for their River Rouge plant.

One of these features is, what might well be termed, a "full vision" air conditioned crane cab, and is the first known installation of its type.

The term "full vision" applied to crane cabs refers to one in which the four sides from floor to ceiling are constructed of transparent material, permitting complete vision in all directions, the only blind spot being that portion of the plant floor obscured from the crane operator's vision by the cab floor itself. From the vision diagram of Figure 1, it will be noted that this type of cab permits the crane operator to view all the crane operations while sitting in a normal comfortable position in the cab seat. The enclosing wall, Figure 2, directly in front of the operator is inclined so that the lower section forms a plane which is perpendicular to the vision line from the operator's eye to the top of the mold, thus reducing refraction and eye strain that would be otherwise experienced.

Since both sides and the rear wall, Figures 2 and 3, are transparent the operator can view with ease all plant activities, thus facilitating crane movements in any direction. This feature permits increased interest in all operations, thus tending to reduce the feeling, on the part of the operator, of being confined, a feeling which is frequently experienced in cabs of standard design enclosed with non-transparent walls and small glass windows. The psychological advantages of reducing the feeling of claustrophobia are somewhat intangible but the morale of the operator is definitely increased.

The design of a full vision cab presents four major problems, all of which require a considerable amount of thorough study and investigation. The first of these is the type and kind of controls; second, proper selection of the material for the transparent enclosing walls; third, the material to be used and the kind of construction for the entire crane cab; and fourth, the design of the air conditioning equipment.

Regarding the first of these problems, it might be well to mention that in cabs of standard construction, operators generally work from a standing position in controlling the movements of a crane. The master switches of the magnetic control are mounted at the front of the cab, on a common base with operating handles located about level with the operator's waist, so that his forearm is approximately parallel to the cab floor. In some instances, as on cranes having five or more motions, the mounting may be divided with some master switches suspended from the cab ceiling.

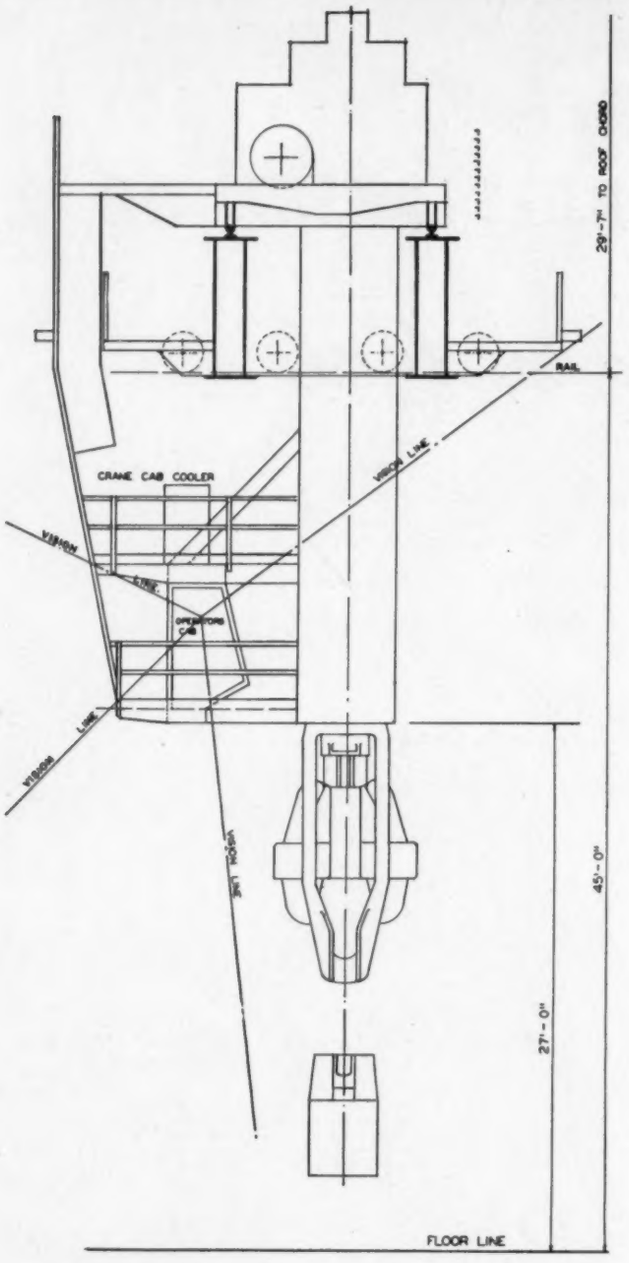


Figure 1 — From his seat in the cab, the crane operator can easily see his work.

However, in the full vision air conditioned cab, it was desired to have the operator seated, with control-levers conveniently grouped about him yet without obstructing his vision. Also, since the dimensions of the cab are small, in order to reduce the work of the air conditioning equipment, careful consideration had to be given to the mounting of the master switches.

A method of remote operation of the standard master switches was employed which resulted in minimum cab space requirements and which also provided ready operation from the operator's seat. The location of the small pedestals projecting up from the cab floor that house the controls can be seen in Figures 2 and 3. The master switches handling the control circuits to the magnetic controller are mounted outside the cab. Hydraulic actuators are used which are mounted on the master switches and geared to the operating arm of each to move the master switch in either forward or reverse direction. Hydraulic transmitters, also of the reversing type and with straight line lever operation, are mounted in the cab and are connected by tubing to each receiving actuator. Fluid of the type commonly used in hydraulic automobile brakes is the medium for transmitting the motion. The hydraulic units used are of the balanced type giving accurate operation in either direction and are also self-correcting to compensate for temperature change in the fluid.

The master switches, remotely operated by these hydraulic units, are of mill type construction and are arranged for straight line operation. The short overall throw from the full forward to the full reverse position requires an equally small movement of the handle of the hydraulic-transmitter. The ability to feel the individual speed points is retained with these hydraulic-operated master switches.

The arrangement described above occupies a small amount of cab space and in no way interferes with the full vision of the operator. This arrangement also makes it possible for the operator to sit well back in the seat, and yet obtain full speed control in either direction without having to lean far forward or to cramp his forearm against the back of the chair when pulling the lever backward.

Investigation and study as to what material should be used for the walls, resulted in the use of the transparent enclosing wall construction shown in Figure 4 and consists of two pieces of a ¼ in. surface hardened plate glass set ½ in. apart in a built-up frame. The glass is set in ¼ in. asbestos gasket tape but is not a hermetically sealed double glazed partition. The exterior layer of glass is surface hardened heat absorbing plate glass. This plate glass was selected because it is claimed to be four times as strong and flexible as ordinary plate glass and very much more resistant to impact. It is little affected by varying surface temperatures, being able to stand, without breaking, a temperature of 650 F on one surface, while the other is at ordinary atmospheric temperatures. In the event the glass should shatter, it does not break into sharp fragments like ordinary plate glass, but disintegrates into innumerable small fragments which are comparatively blunt edged.

The surface hardened heat absorbing plate glass was used for the outside surface for a number of reasons. It is slightly greenish in color and consequently tends to reduce glare from the red hot ingots. Under temperature conditions of 135 F ambient and 85 F inside the cab, the "U" value (over all heat transmission value) for the double glazed vision wall construction is 0.52 Btu per sq ft per hour, per degrees F temperature difference in comparison to a similar value for single glass of 0.83 Btu. This represents a saving of approximately 37 per cent of the normal amount of heat transmitted by conduction through the glass area. This value is exclusive of the radiant energy of the hot steel. The heat absorbing glass was designed to be particularly

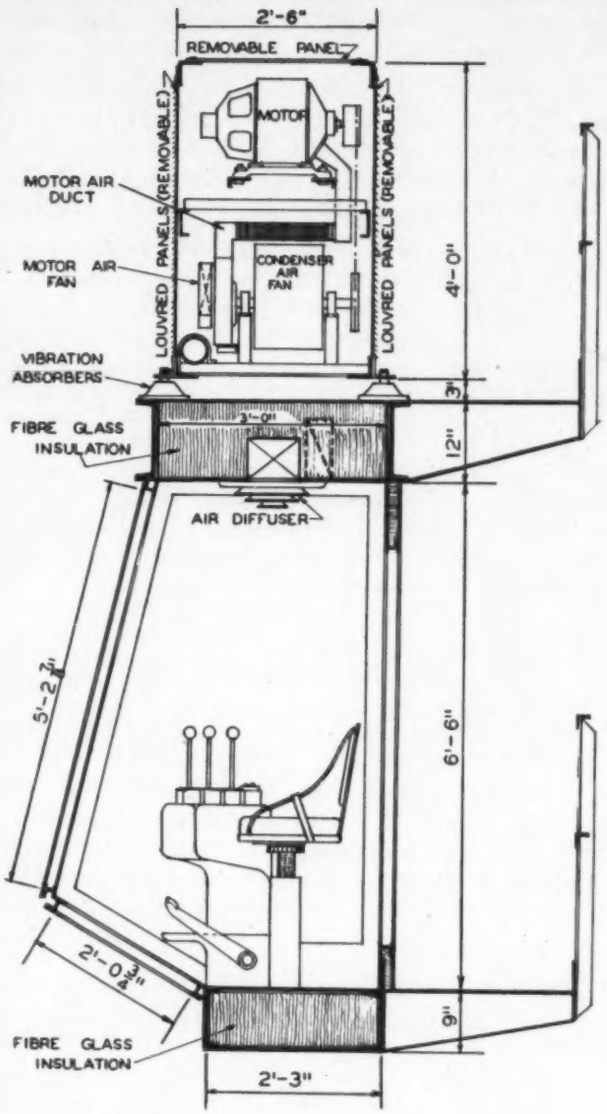


Figure 2 — The front cab walls are sloped to reduce glare.

effective in reducing the solar radiation transmission, and although the radiant energy from the hot steel does not duplicate the wave length, range, and intensity of the sun, the use of the glass in this location does assist in reducing the radiant energy transmission through the glass partitions of the cab. The effectiveness of the glass increases as the temperature of the operation increases.

The entrance door of the cab is also constructed of this double glazed plate glass construction.

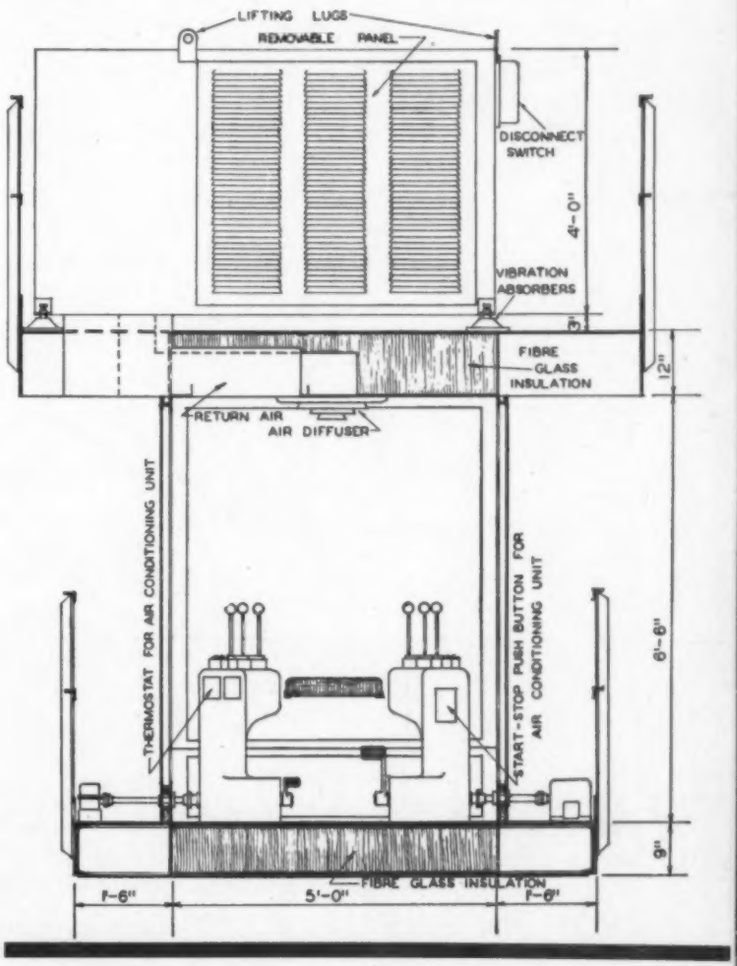
The entire design and construction of the cab had to be such that a comparatively low heat gain would result, thus relieving somewhat the normally heavy demands imposed upon the air conditioning equipment in this type of an installation. Having selected the type of glass wall construction to be used as discussed previously, it was only necessary to determine what the floor and roof construction should be. Since both floor and roof were to be hollow compartments in effect, it was actually only necessary to determine the depth of these compartments relative to the thickness of the insulation required to offset the heat conducted and the radiant effect of the hot ingots. Figures 2 and 3 show the thickness of the insulation. Fibre glass was used for the insulating material and completely fills the hollow space in the floor and roof.

The 9 in. of insulation in the floor were sufficient to permit the hydraulic control lines to be installed there, and to insulate these lines against the high temperatures anticipated in the operations of this crane.

The 12 in. of insulation in the roof provide insulation against heat transmission into the cab from high ambient temperatures and also furnish insulation for the short supply and return air ducts from the air conditioning unit to the cab. The small duct transitions from the supply and return air openings in the air conditioning unit which are not enclosed in the cab roof construction are of galvanized sheet metal covered with 1½ in. of impregnated fibre insulation.

The crane cab, fabricated in accordance with the foregoing discussion, provides the necessary insulating qualities to the extent that a temperature of 85 F can be maintained in the cab during the cooling season, when subjected to 135 F ambient temperature, and 70 F can be maintained during the heating season when the outside temperature is 0 F.

Figure 3 — The cab cooler is mounted directly on top of the cab.



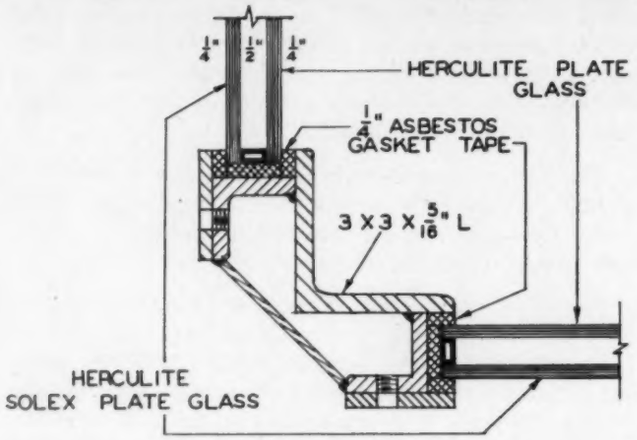


Figure 4 — The glass walls of the cab have air spaces to reduce heat transmission.

The air conditioning unit furnished with the cab had to meet these performance requirements and also provide the means for removing fumes, odors, gases, and dirt from the air supplied to the cab.

The unit selected was an air cooled self-contained crane cab cooler built by the writer's company, the design of which was based on many years of experience in commercial and industrial air conditioning. Among these experiences was the air conditioning of a crane cab in 1943 in which air was used for condensing purposes. It is believed that this was the first installation in which air was used instead of water. The cab involved, operated in atmospheres where lead fumes existed, and required toxic fume and gas removal in addition to the normal functions performed by air conditioning equipment.

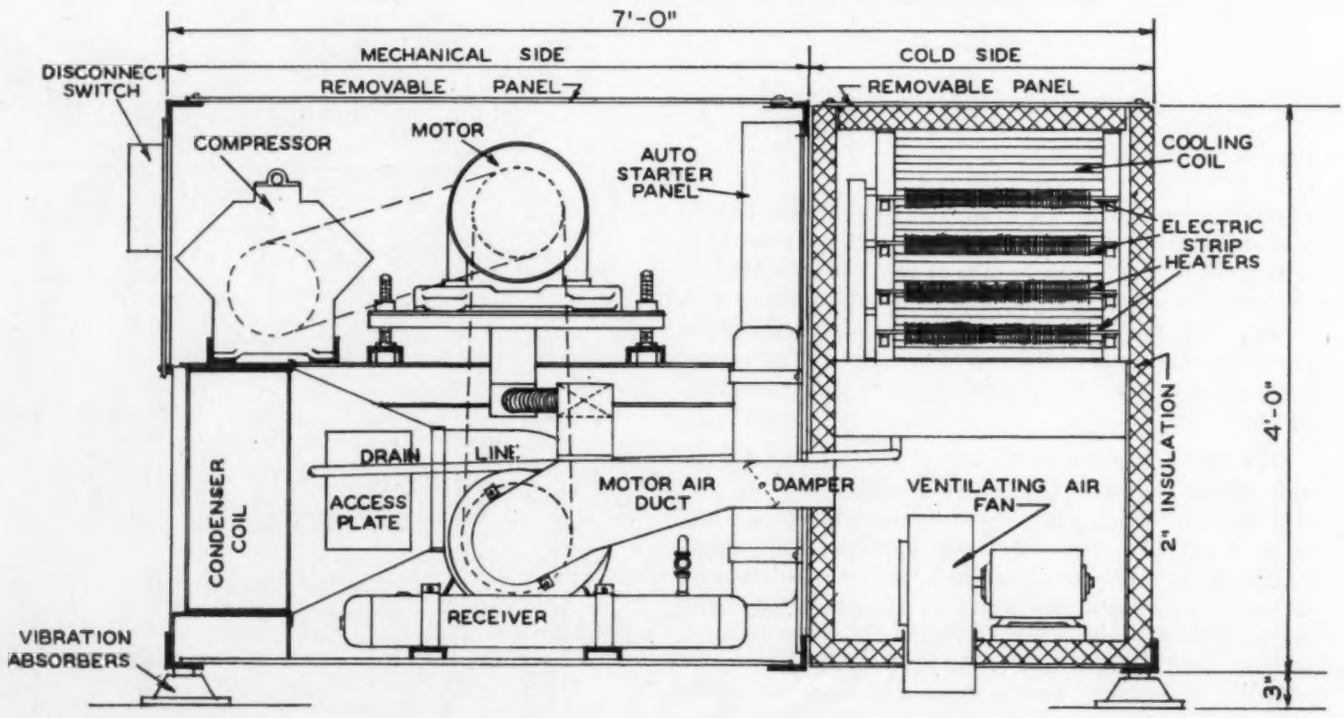
The results of all these experiences brought out the basic fact that any unit offered to industry had to be rugged, heavily constructed. All equipment furnished as component parts of the cooler should have capacities greatly in excess of the theoretical calculated capacities.

The sturdiness of the cooler can be seen from Figure 5. The frame is composed of 3 × ¼ in. angles with 4 × 1½ × ½ in. channel horizontal supports, all of which are of welded construction. The entire cooler is supported at each corner on vibration absorbers to assist in relieving the vibration, shock, and jarring to which this equipment is subjected.

The crane cab cooler is divided into two compartments as shown in Figure 5, the cold side in which the air supplied to the cab is conditioned, and the mechanical side, in which is located the refrigeration equipment, compressor motor, contactors and starters.

The cold side is an insulated box, all four sides, top and bottom being insulated with 2 in. of fibre-glass. The top and front panels are completely removable for ready access and maintenance. A section through the cold side, Figure 6, shows the flow of air as it is ultimately supplied to the cab. Approximately 100 cfm of make-up air is introduced into the unit through a dust filter and also through activated carbon cannisters for removing fumes and gases. This make-up air mixes with approximately 300 cfm of recirculated air and passes

Figure 5 — The cooler is divided into two distinct sections.



over the cooling coil into the ventilating air fan which operates continuously. Four, 1000 watt electric strip heaters, with a total capacity of 13,600 Btu, for winter heating, are located directly in front of the cooling coil. A total of 400 cfm of air is discharged through an air diffuser into the cab, and since only 300 cfm is returned to the cooler, a pressure is built up within the cab.

Since the sides, floor, and ceiling of the cab are comparatively hot surfaces, it was necessary to carefully select an air diffuser that would permit a sufficient air movement along the inside face surfaces, in order to create a cooling effect, and also to reduce the radiant effect generated by abnormally high temperatures. The air diffuser further had to give a diffusing effect immediately around the crane operator. The diffuser selected was the type which discharges the air in an outward and downward movement, thus effectively washing all the hot surfaces of the cab. The air returning to the crane cab cooler at the roof level, assists in reducing the radiant effect of that surface.

The dust removing filters are the wire mesh cleansable type, the air entering side being a large gauge mesh, with successive layers of mesh decreasing in size in the direction of the air flow. The selection of these wire mesh filters was based on previous experiences in industrial air conditioning where it was found that this type withstood the rough usage experienced more satisfactorily than other types.

From Figure 6 it will be noted that the air discharged into the cab is actually filtered twice; first, as the air enters the unit as make-up air and second, as the air returns to the unit as recirculated air prior to its entering the cooling coil.

The supply and return air openings in the cooler are located in the floor of the cold side, see Figure 6. This location eliminates the necessity of expensive heavily insulated ducts if the cooler can be installed directly over the cab. Note from Figure 3 that only very short ducts were required in this installation. These ducts, installed in the roof construction, could be rigidly secured, thus reducing the possibility of their being jarred or shaken loose from their connections.

At this point, it might be well to discuss the methods of controlling the functions performed by the crane cab cooler. It is a well known fact that all control mechanisms, including heavy duty industrial types, are somewhat delicate by nature of the function they perform. Consequently, the cooler was designed to require as few controls as possible compatible with proper and efficient operation and performance.

A two pole, push button type thermal overload switch and a combination cooling-heating thermostat with a selector switch are installed in the cab. The location of these controls is shown in Figure 3. The push button switch permits the continuously operating ventilating air fan to turn over and start to deliver air into the cab. When this fan starts to operate, the thermostat takes over, permitting automatic operation of the cooler based on the temperature demands in the crane cab. In the event that the ventilating air fan does not turn over, the mechanical operations of the entire cooler are automatically cut out.

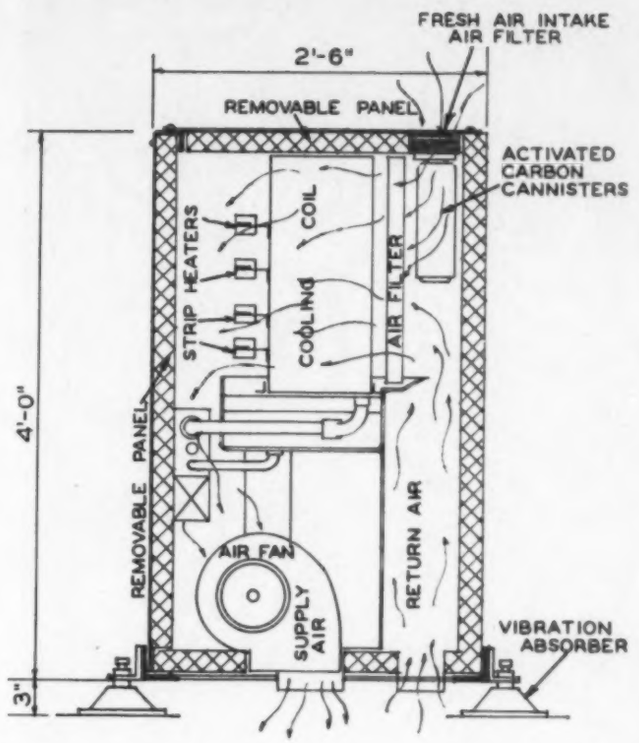


Figure 6 — The cooler is mounted so as to reduce vibration.

The push button switch and combination cooling-heating thermostat in conjunction with the main disconnect switch, two-step resistor type compressor motor starter, and automatic contactor for the electric strip heaters make up the complete control system which is neither intricate nor complicated.

The mechanical side is enclosed on both sides with louvred panels and with a solid panel on the top. Both side panels and the top panel are easily and completely removable, permitting access to the equipment from any angle. The absence of equipment crowding for easy maintenance can be seen in Figure 5. Ease of maintenance is of prime importance since minor repairs and normal maintenance will be carried out under the usual operating conditions, which in this instance means high ambient temperatures. This feature will also represent savings in repair shop time, since major repairs and changes can be made quickly and easily, resulting in the cooler being placed back in operation with a minimum amount of lost operating time.

The upper platform of the mechanical side supports the 5 hp compressor motor and refrigeration compressor. The lower platform supports the condenser coil, condenser air fan, motor air fan and receiver. The 5 hp compressor motor is connected to the condenser air fan with one oil and heat resisting belt, and to the compressor with two oil and heat resisting belts. Since only a total of 4.2 brake horsepower is required for the operation of the compressor and condenser air fan, the 5 hp motor is ample in capacity and eliminates the necessity of a separate motor for the condensing air fan.

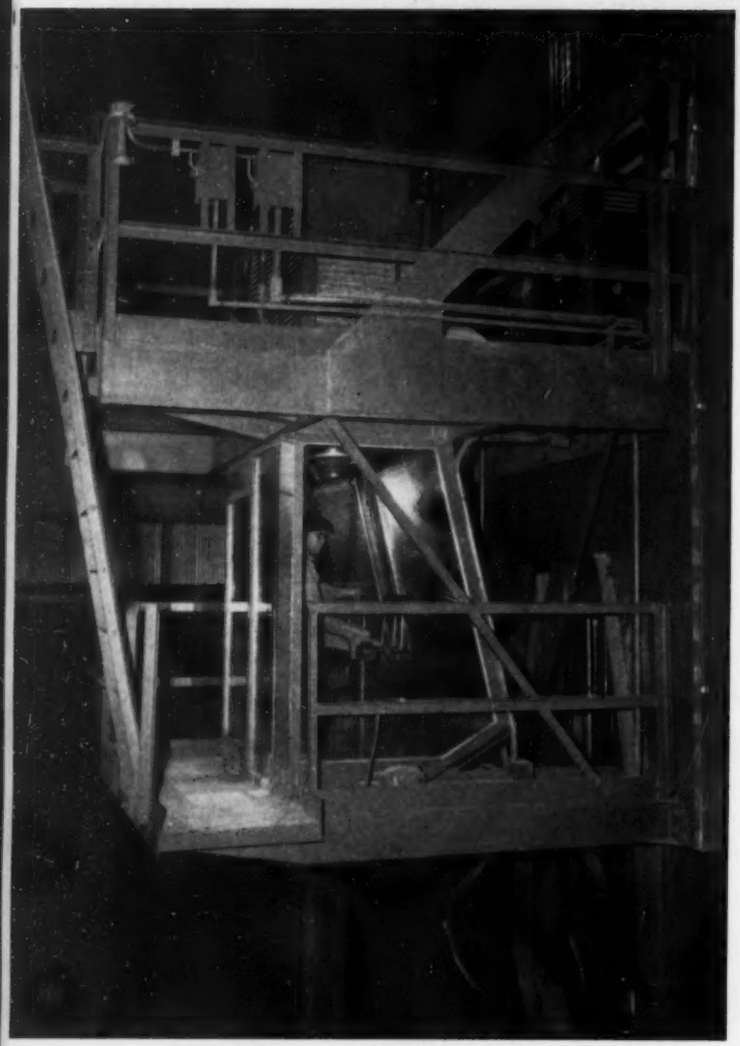


Figure 7 — Full vision crane cab on stripper crane in Ford Motor Company, River Rouge plant.

In the design of the crane cab cooler, recognition is taken of the difficulties encountered with the operation of motors at high ambient temperatures. A positive, forced air ventilating system is built into the cooler for the compressor motor. A small auxiliary fan, Figure 5, called the motor air fan is installed on the same shaft as the condenser air fan. This motor air fan is connected to the cold side of the cooler and also to the sheave side of the 5 hp motor by means of small ducts. The duct connection from the fan discharge, extending over the top of the condenser air fan to the motor, is shown on the cross section of Figure 2.

This ventilating system furnishes cool, 60-65 F, and clean air, filtered twice, to the motor permitting it to operate at the normal temperatures at which it is rated, and also helps to dissipate the heat generated by the motor. Since this air is quite free of dust particles, considerable savings result in the reduced wear of brushes and moving surfaces of the motor. Experience indicates that the ventilating system so installed assists materially in decreasing motor breakdowns and failures.

The condenser air fan is a centrifugal squirrel cage double inlet, double width fan, furnishing approximately 2000 cfm over the condenser coil which is an extended surface coil. The condenser coil, and the cooling coil, is made with aluminum fins bonded to a serpentine copper tube heat exchanger.

Since the condenser coil will require periodic cleaning, an access door is provided so that a hose can be inserted discharging steam or compressed air across the face of the coil. This will loosen any accumulation of dirt and dust after which it will be blown out of the coil by the air fan.

As air to be conditioned passes through the cooling coil, moisture is condensed which drops into a collecting pan. If this water were permitted to accumulate, it would splash around due to the severe jarring and shaking to which the cooler is subjected. Splashing of this water would ultimately cause rusting or corrosion of the wetted surfaces. In order to remove the condensate as rapidly as it forms, a copper tube is connected from the drip pan, Figure 5, to a pierced tube fastened at the top of the condenser coil. This pierced tube permits the water to drop, through small holes, down the air entering side of the coil, from which it is blown through the coil and discharged out into the plant by means of the high velocity condensing air.

One of the contributing factors to the successful operation of the crane cab cooler is the proper selection of the refrigerant. Since air conditioning equipment is designed generally to operate at around 100-125 psi, it was necessary to use one which would give low operating pressures at high ambient temperatures. This requirement was the reason for selecting Freon 114 as the refrigerant. Freon 114 has a considerably higher boiling point than Freon 12, the refrigerant normally used in comfort air conditioning. As a comparison, at 140 F ambient temperature, the gauge pressure with Freon 114 is approximately 71 psi and approximately 206 psi for Freon 12. As can be seen from the above, the use of Freon 114 permits operating pressures considerably below the limits of the equipment.

Experience from previous successful installations, one of which represents two years of continuous operation, indicates that each of the above features contributes to the satisfactory performance and low maintenance costs of the crane cab cooler. The installation of the complete full vision air conditioned crane cab, as discussed herein, is shown in Figure 7.

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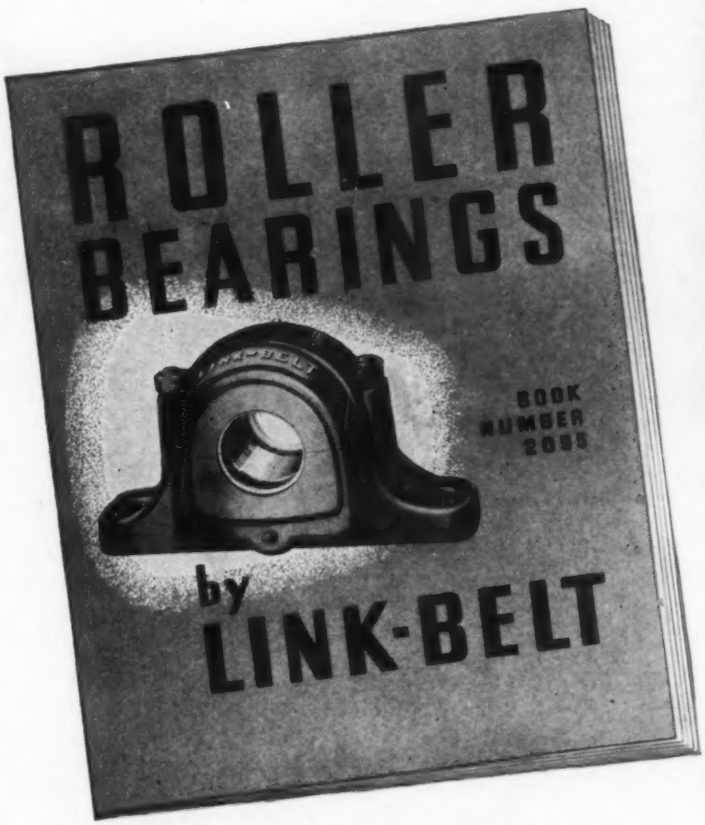

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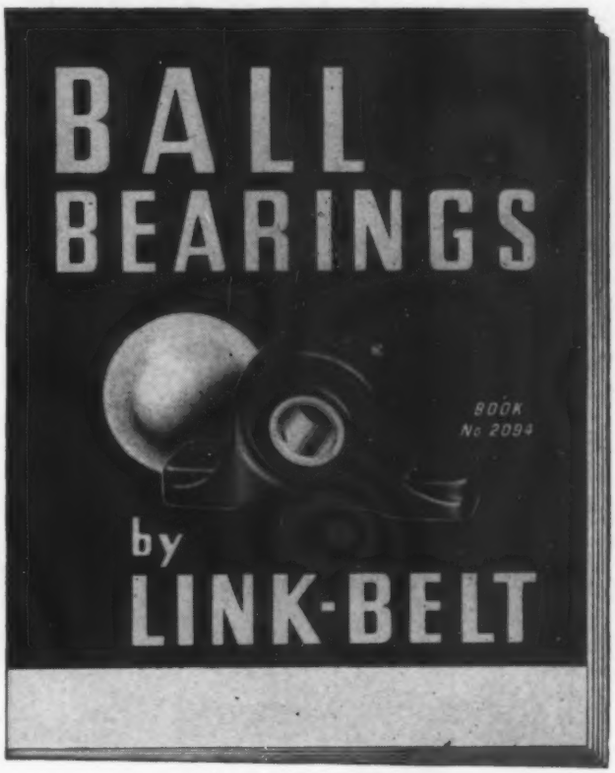

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Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8.
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10,502

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When You Wire with ROCKBESTOS A.V.C.

Permanent Insulation *Insures* Long Trouble-free Service

Rockbestos A.V.C. 600 Volt Power Cable above and similarly insulated Motor Lead Cable (Nat. Elec. Code Type AVA) have a maximum operating temperature of 110° C. (230° F.) and this permanent insulation:

1. The conductor is perfectly and permanently centered in helically applied non-flowing insulation that provides greater current carrying capacity.

2. Inner wall of impregnated felted asbestos withstands conductor-heating overloads and won't bake brittle or burn.

3. Asbestos-protected varnished cambric for high dielectric strength and added moisture resistance.

4. Heat, flame and moisture resistant impregnated felted asbestos insulation that won't dry out, crack, flow or rot.

5. A tough impregnated asbestos yarn braid, resistant to heat, flame, moisture, oil, grease and corrosive fumes.

One of the 125 different constructions designed by Rockbestos for severe or unusual operating conditions.

You can give your trouble-shooting kit a rest if you survey your trouble-making circuits and specify wire or cable that can take tough operating conditions *continuously* without failure.

Maintenance really becomes a minor problem when you install Rockbestos A.V.C. wherever heat and corrosive fumes are major wiring hazards. Insulated with *impregnated asbestos*, Rockbestos wires and cables permit continuous operation under high temperatures and other failure-producing conditions. They won't bake brittle, crack or flow under heat up to 230° F., and because the *insulation is permanent*, they won't deteriorate with age.

There are 125 standard Rockbestos constructions in 300 to 5000 volt ratings, including single and multi-conductor power cables, switchboard and lighting wires, control cables and N.E. Code types. Send for catalog and samples.

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The Wire with Permanent Insulation

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NEWS SUPPLEMENT January, 1947

Equipment
Personnel
Literature

Iron AND Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

ELECTRICAL AND ALLIED DEVELOPMENTS IN 1946

By GUY BARTLETT

GENERAL ELECTRIC COMPANY

▲ 1946 — the first full peacetime year since V-J day — was a year of much progress and many headaches in the electrical manufacturing industry. The progress was, for the most part, in application engineering, in design engineering, in fundamental research — that will lead to more efficient production, lower cost and less maintenance, to faster and more precise operation, to the application of electricity to more and more processes, and to the introduction of new machines and controls to accomplish things previously not possible.

MOTORS

Featuring increased horsepower in smaller space, a new line of direct-current armored mill motors was brought out in sizes from 5 to 200 hp. The motors have improved commutation, higher efficiency, and better internal ventilation. Close-coupled solid roller bearings provide greater load-carrying capacity, and the adaptability of the frame to the various enclosures enables easy changeover between protected, totally enclosed, or separately ventilated types. Factors contributing to the reduction in size per horsepower include the better utilization of space inside the machine, and glass insulation instead of asbestos. All existing AISE standards pertaining to temperature, horsepower, speed, and mounting dimensions are maintained.

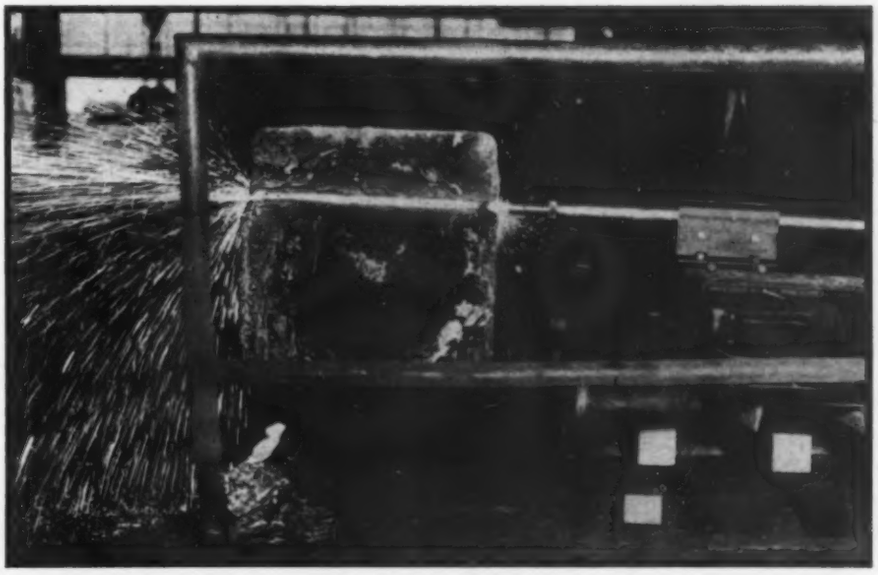
For operations in severe atmospheric conditions, such as prevail in steel mills, a new line of unit-cooled, totally enclosed, direct-current motors was developed in sizes from 15 to 200 horsepower. A dual ventilating system utilizes a compact unit-cooler to give air-to-air cooling. The cooler has two sets of air passages, at right angles to each other. A fan on the armature circulates air through the motor and through one set of passages which form a completely enclosed system. External air, maintained at a constant rate of flow by an auxiliary motor and fan, travels through the other set of passages to absorb heat from the enclosed system. A totally enclosed construction is thus achieved without external duct work, piping, air filters, or pressurized air supply.

Vertical motors from 1 to 500 hp, with hollow or solid shafts, were added to the line of Tri-Clad motors. Of distinctive appearance, they have standardized NEMA Type P bases.

The line of totally enclosed motors, both standard and explosion-proof, was extended to include all ratings through 1000 hp.

New NEMA standards for fractional-horsepower motors were adopted, providing specific definitions of motor rating and performance in coordinated terms of horsepower rating.

OXYGEN BLOWPIPE EXPEDITES SCRAP PREPARATION



The Oxweld C-45 blowpipe, which is shown here making a trial cut preliminary to a sectioning operation on a 35,000 lb gun barrel forging, is capable of cutting steel up to 66 in. in thickness. This torch was developed during the war and has cut operating time to a fraction of that formerly required. The torch reverses the usual theory of using higher oxygen pressures for increases in material thickness as is normal on smaller blowpipes on material less than 20 in. thick. While larger nozzles are employed for increases in material thickness, the optimum blowpipe oxygen pressure decreases steadily with increases in nozzle size, reaching a low of 7 psi for material over 4 ft in thickness.

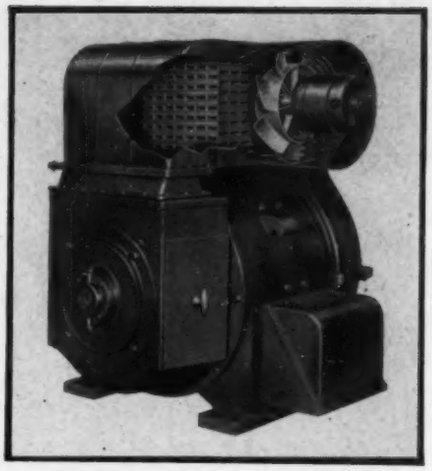
Of particular interest to steel men is the replacement of the oxygen lance by the new blowpipe to reduce off-heat and other types of scrap ingots to furnace-charging sizes. One mill is using the blowpipe to reclaim 140 tons of ingots per day, using 110 cu ft of oxygen per ton, on ingots ranging from 32 to 55 in. thick. Linde Air Products Company.——1-E-1——

speed, breakdown torque, and service factor. Dimension and application standards are also to be included. The standards are of major interest to motor users, machinery and appliance manufacturers, application engineers, electrical contractors, power companies, and the motor manufacturers, particularly in view of the fact that previous efforts toward effective standardization have resulted in lower production costs while the volume of standard motors has increased many times.

The amplidyne, previously considered a d-c machine, was developed for a-c operation. The a-c amplidyne is a synchronous alternator whose frequency is determined by the frequency applied to the control fields. Its sensitivity and speed of response are comparable to the d-c amplidyne, so it is now possible to control a substantial amount of a-c power with such low power sources as crystal oscillators. Automatic control of power-system frequency is one suggested application. A combined pump-drive motor and motor-alternator set, developed for use on diesel-electric locomotives, operates on 75 volts battery power on the locomotive, and supplies three functions. The oil pumps, one on each end, supply high-pressure hydraulic power for actuating the diesel-engine governor, and moderate-pressure diesel fuel oil for the engine injector mechanism; and the self-excited alternator supplies 1000 volt-amperes at 400 cycles for the generator and train control. The fan-cooled, totally enclosed machine occupies less space and costs less than the one it replaces.

Half-case construction features a new fractional-horsepower motor for office devices. The field core is supported by three pads, and all case-machining is done from these pads to insure alignment and concentricity. They are single- or two-speed, governor-regulated series motors, the two-speed equipment having a built-in transfer switch actuated by the office device for changing speeds.

Additional fields of application were opened for the unit-bearing motor, which had proved its reliability and long life in the a-c fan-duty field. Ratings from 1.5 watts to 1/25 hp were added, with small water pumps and hair dryers among the new applications. One unit-bearing motor of particular interest is a ¼ hp, 4-pole unit in the 40-frame size, used on a domestic dishwasher unit and operating vertically with a main drive-shaft extension 6½ inches beyond the bearing. The lower part of the motor, housing the bearing, oil wick and other lubrication features, adapts a direct-drive timer.



Totally enclosed d-c motor with unit cooler, cut away to show air-to-air heat exchanger.

CONTROL

Snap-action oilproof limit switches were augmented with a new standard-size limit switch and a smaller track-type unit having interchangeable operating heads for roller lever, roller rush rod, push rod, or plunger operation. The heads can be rotated in 90-degree increments, providing four different operating planes with respect to the mounting surface of the switch. The oilproof molded enclosure houses a single-pole double-throw snap-action contact switchette.

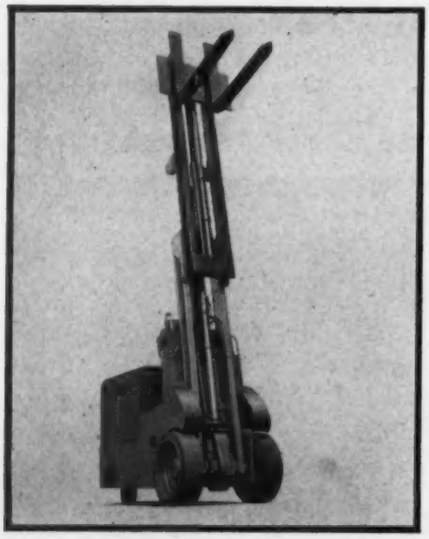
For floor-operated cranes there was produced a pendant pull-station control giving the same ease and refinement of control that is available in large cab-operated cranes. A simpler, smaller magnetic control panel is mounted on the floor crane and connected to the new pendant pull station. The pull station is operated by pulling handles, each of which controls one direction of crane motion. It provides a maximum of five speed points with time-delay acceleration.

Most of the year's developments in "Thy-mo-trol" control were in the form of improvements in the electronic circuits and in the construction of the control panels. Most important in the electronic motor-control circuits was the speeding up of the response to obtain faster IR compensation for maintaining closer speed regulation and for better jogging operating. Control panels were improved by more orderly arrangement of the circuits and rigid mountings of the components to simplify the servicing problem and to provide space for adding auxiliary devices needed for special applications.

A simplified equipment was produced for fractional-horsepower ratings up to ½-hp maximum. It is a half-wave type unit with only two tubes, and will fill the need for inexpensive equipment for use on industrial mixers, dental lathes, etc., as well as for miscellaneous machine-tool applications.

A control for automatic one-way contouring will be used largely on lathes and other machines where the accuracy and cost of a two-way control are not justified. The electronic panel in combination with an ampli-

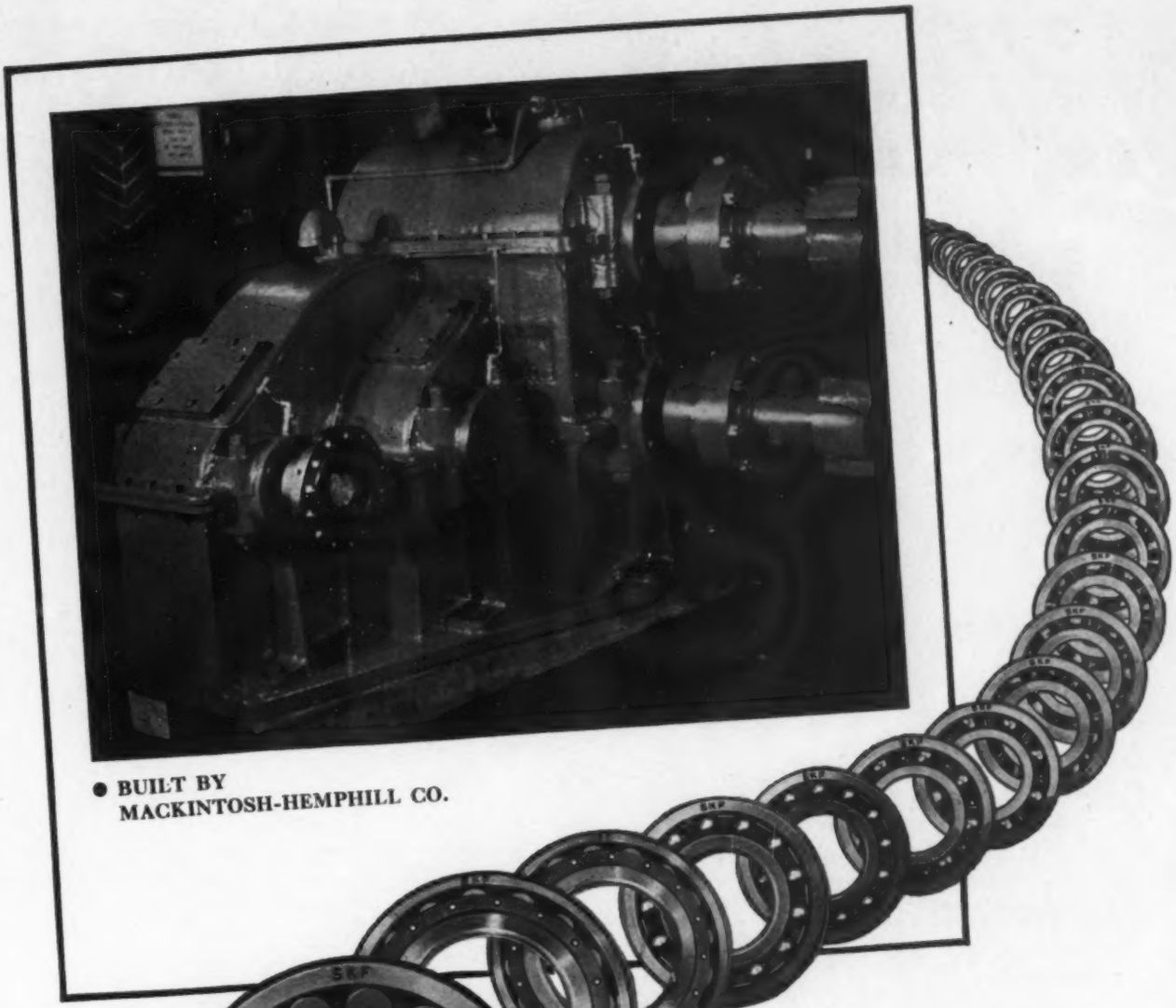
THE SKY'S THE LIMIT!



With forks towering 130 inches above the floor, this truck is the "Sky Lift," new hydraulic unit just announced by Automatic Transportation Company. Its lift is higher than any fork truck of any type with a standard 83-inch collapsed height and fully ten inches higher than any other hydraulic truck. The "Sky Lift" is the first of Automatic's 1947 line of trucks. Scheduled for early first-quarter production, it will be made in 2000, 3000 and 4000 pound load capacity models.

A product of war-time research on high-pressure hydraulics, the "Sky Lift" is the first Automatic truck to use an hydraulic lift, but the high-pressure system makes it a smaller and lighter truck than pre-war models of similar load capacity with mechanical lifts.

——1-E-2——



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SKF
Puts the RIGHT BEARING in the RIGHT PLACE

To obtain continuous, trouble-free performance, a number of combination drive and pinion stands operating at the LaGrange plant of Reynolds Metals are completely SKF-equipped. SKF Spherical Roller Bearings possess an equalized load distribution that assures full bearing capacity and long life . . . built-in alignment that relieves the tendency of outer races to "pound out" their seats under heavy load and resultant shaft deflection. Another outstanding example of the right bearings in the right places in the Steel Industry. 6194

SKF INDUSTRIES, INC., PHILA. 32, PA.

The new forged steel CHIKSAN XH Swivel Joint combines the easy turning and effective pack-off — for which all CHIKSAN Joints are noted — with high capacity. Built of forged steel, with flame-hardened races, this new CHIKSAN Joint is designed for heavy duty services of all kinds. It makes possible the fabrication of all-steel lines with perfect flexibility, yet capable of withstanding working pressures to 12,000 psi... with greater safety and longer life. Engineering data on request.

In addition to the new CHIKSAN XH forged steel Swivel Joint, there are over 500 different Types, Styles and Sizes available for pressures from 300 to 3000 psi, and temperatures to 500° F.

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CHIKSAN

BALL BEARING SWIVEL JOINTS FOR ALL PURPOSES

CHIKSAN COMPANY

BREA, CALIFORNIA

New York 7 Houston 2

dyne generator supplies power for the feed motor.

A compact electronic control was developed for exciting an amplidyne generator to regulate voltage speed or current. The control extends the useful range of the amplidyne by increasing the sensitivity of the regulating system and, in addition, synthesizes several control function signals and delivers the proper excitation to a single pair of amplidyne control fields. One of the most common applications is as a voltage regulator with IR drop compensation and current limit. When used as a speed regulator with tachometer voltage feedback, accuracies of a fraction of 1 per cent of rated speed have been achieved from no load to full load.

MILLS

In the tremendous war-expansion of the steel industry, the emphasis was on increase of primary steelmaking and facilities for producing the so-called semi-finished steel products such as heavy structural shapes, plates, etc. Attention since the war has been largely directed to the so-called finished products, involving cold-rolled and finished sheet and strip, light structurals, rods, bars, etc. Despite serious and continuing production difficulties, much progress has been made.

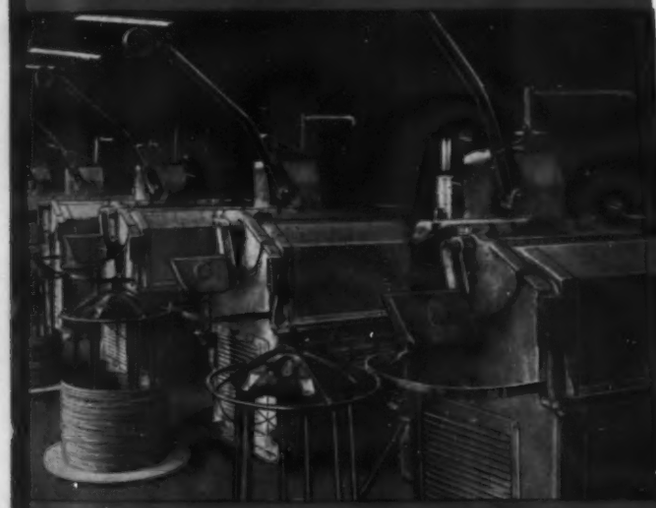
A great deal of time and effort went into the laying out of high-speed tandem cold strip mills during the past year, and a large number of the finest mills ever designed are being built. Several of these will go into operation near the end of the year. The individual generator scheme for tandem mills, first introduced in 1945, was applied to four mills — three of which have maximum speeds in excess of 4000 fpm. As a result of the increasing mill speeds, the use of step-down gears has diminished considerably and direct-connected motors or step-up gears are in the majority.

The regulating tensiometer has now come into its own for controlling the winding reels on at least three of the new high-speed tandem mills and on one of the reversing mills. This device, although previously used to some extent for regulating winding reels, will find more extensive application as mill speeds increase and the range of products rolled becomes greater.

In the field of tandem mills, a new four-stand mill for rolling silicon and stainless steel will go into operation

VAUGHN MOTOBLOX

VAUGHN MOTOBLOC



VAUGHN CONTINUOUS MACHINES

EVERY MONTH IN 1947

—as always for the past 20 years

Vaughn

COLD DRAWING MACHINERY

will have a vital share in the performance records of industry

In every field where ferrous or non-ferrous metals are cold drawn—into wire, bars, tubes or special shapes—Vaughn Machinery is a major element in producing *more product at lower cost.* Use the Vaughn performance factor in your 1947 plans!

The VAUGHN MACHINERY COMPANY
CUYAHOGA FALLS, OHIO, U.S.A.

COMPLETE COLD DRAWING EQUIPMENT . . . Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys.

shortly. A 93-inch three-stand sheet mill is being revamped and speeded up. A 56-inch high-speed five-stand combination sheet and tin plate mill is being built for installation on the West Coast. For installation in the Chicago area a 40-inch, high-speed, five-stand tandem tin plate mill is being built. An existing 42-inch, five-stand mill will be speeded up and the power increased by the substitution of a 2000 hp, 500/900 rpm motor for the existing 1250 hp, 350/790 rpm motor on stand No. 5. A two-stand tandem brass mill is being constructed with a synchronous motor on the first stand, and d-c motors with adjustable voltage control on the second stand end on the reel.

Two Sendzimir cluster-type mills are being built for production rolling, the first a 19-inch and the other a 40-inch mill. They use two reel motors in series for low speeds and heavy tensions, and only one motor for high speeds and lighter tensions. Other reversing mills included a modified cluster-type mill of the "Y" type, duplicating an equipment of the previous year; a new 29-inch, four-high, reversing cold strip mill to roll stainless steel, duplicating a 1941 installation; and a 6-inch, ring-type, cluster mill to roll silver.

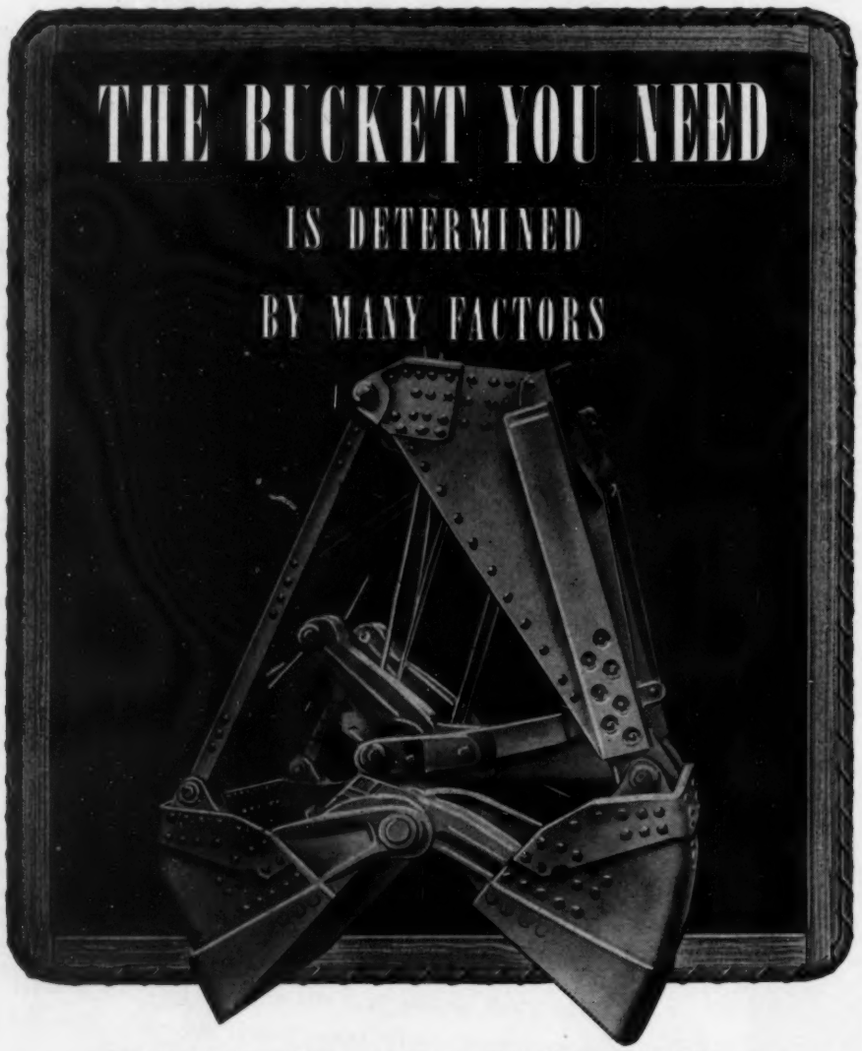
With finished products playing such an important part in the year's activities, processing lines really came "into their own." In addition to revamping and speeding up a number of existing lines, steel companies also started work on an unprecedented number of new and modern lines, many of them incorporating ideas resulting from war developments.

A new semi-continuous strip-steel pickler was being built with adjustable-voltage control. Two new combination annealing and pickling lines were being produced for stainless steel. For brass strip there was a continuous annealing and pickling line. Two high-speed electrolytic cleaning lines were being built with adjustable-voltage control and amplidyne control of unwinding and winding tension.

A 38-inch side trimming line is to operate at 1800 fpm. A 36-inch line will be used at 3000 fpm, without loops. On the West Coast there will be a 24-inch slitting line with a speed of 1500 fpm. For stainless and silicon steel two 26-inch, 300-fpm, and one 40-inch, 400-fpm slitting lines were being made.

Six tin plate shearing lines and two sheet shearing lines are being provided with adjustable-voltage control, and six of them with photo-thyratron loop control. A shearing line for stainless steel will use an electronic-amplidyne synchronized tie to eliminate the conventional gearing between the measuring rolls and the shear.

Continuous strip plating lines of the electrolytic and hot-dip variety have "stolen the show" so far as processing lines are concerned. One combination annealing and galvanizing line will use a combination 9600-cycle induction and resistor heating furnace with five independently adjustable cooling zones. Two zinc-coating lines will use copper-oxide rectifiers for low-voltage plating power. A combination annealing and galvanizing line, recently put in operation will use a newly developed electronic-amplidyne system of start-stop shear control which eliminates the conventional gauger table and all contactors, solenoids and brakes. A continuous terne plating line is also being built. All these plating lines use



That is why Blaw-Knox maintains a list of over 100 different types and sizes.

Blaw-Knox Catalog 2002 contains sufficient information for you practically to "order by mail" exactly the clamshell you need for a particular bucket use.

Send for a copy of this informative catalog.

BLAW-KNOX DIVISION of BLAW-KNOX COMPANY
2040 FARMERS BANK BUILDING, PITTSBURGH 22, PA.

BLAW-KNOX BUCKETS

Still looking into the Future

YESTERDAY *. . . Punch, snip or melt . . . a grueling grind for the cutting of Stainless Steels*

Yesterday cutting stainless steel by melting-away or shearing was slow...costly...and with the carbon arc the resulting surfaces were rough and unsightly

TODAY *. . . It's the oxyacetylene flame for production cutting of Stainless Steels*

Today, Airco's new Flux-Injection Method of stainless steel cutting is time-saving and economical. With this new process, stainless steels with alloying elements as high as 50% can be oxyacetylene flame cut as readily as ordinary steels. Used with Airco oxyacetylene equipment, this new method keynotes simplicity and economy. In fact, operating conditions and instructions for stainless steel cutting approximate those for mild steel, and "cut speed" is comparable.

AND TOMORROW . . . ?

Airco's research and development staff will continue to work in this and other fields of metal working to contribute new and better oxyacetylene flame methods . . . creating the techniques and tools of tomorrow. Moreover, the facilities of our Technical Sales Division are available to all metal working men in applying Airco processes to the solution of their problems.

For more information about stainless steel cutting, write for a copy of "Flux-Injection Method Brings Economies of Oxyacetylene Flame Cutting to Stainless Steel". Address your nearest Airco office, or write: Air Reduction, General Offices, 60 East 42nd Street, New York 17, N. Y. In Texas: Magnolia Airco Gas Products Company, General Offices, Houston 1, Texas.

AIRCO **AIR REDUCTION**

Offices in All Principal Cities

ORIGINATORS OF MODERN OXYACETYLENE METHODS FOR THE METAL WORKING INDUSTRY

adjustable-voltage control to cover the wide range of strip speed, and amplidynes where speed or current regulators are required.

Seven annealing lines for silicon strip will have a speed range of 5/20 fpm, using adjustable-voltage control. Thy-mo-trol motor control will be used on the winding reels to maintain a loop ahead of each reel and to compensate for reel build-up.

VOLTAGE REGULATORS

Various war projects had required polyphase dry-type induction voltage regulators for circuits up to 600 v. Redesigned, they were made available during the year for industrial applications such as process control, to hold constant voltage or constant current, or a varying voltage or current following a repetitive pattern. Both single-phase and polyphase designs were included.

BETHLEHEM PLANT TESTS STEEL MILL USE OF OXYGEN

▲ To test the possibilities of using oxygen to speed up iron and steel making, Air Reduction Company has started building a plant at Bethlehem Steel Company's Johnstown, Pennsylvania, works. The unit will produce 150 tons of oxygen (roughly 3,600,000 cu ft) daily. It is scheduled for completion in 1947.

With this unit, Airco and Bethlehem hope to get data on what oxygen will do in full-scale blast and open hearth furnace operations. They also want to determine how cheaply oxygen can be produced in the tremendous quantities required.

Eight times larger than existing commercial oxygen plants of good size, the new unit still is considered only a pilot plant in terms of oxygen needs of a steel mill. Eventually, units 10 to 25 times as large may be required. Purpose in using oxygen to enrich the air is to speed up the reduction process. This may increase by perhaps 25 per cent the output of a furnace.

The Airco plant will extract oxygen from the atmosphere in the conventional manner, compressing, cooling, liquefying, and distilling it to separate out nitrogen and other unwanted gases. The unit will embody numerous departures from conventional techniques. These include turbo-compression in place of the piston-and-cylinder method, and new types of heat exchangers.

——1-E-4——

CURRENT ALLOY TRENDS

Prepared by
Research Department
INTERNATIONAL NICKEL COMPANY

▲ Important progress has been made in the field of metallurgy during the war years which is being used to advantage in the present postwar period. Many new alloys have assumed their place in the metal industry, and as raw materials become more readily available it is expected that wider use of alloys throughout industry will result, according to research engineers of the International Nickel Company, Inc.

A broad series of standard triple alloy steels containing nickel, chromium and molybdenum, in which all of the significant alloying elements are under precise control, have become available to industry as a result of wartime experience. These steels accounted for an exceptionally large tonnage during the war and are still being employed in large quantities by users who find the controlled chem-

(*Please turn to page 137*)

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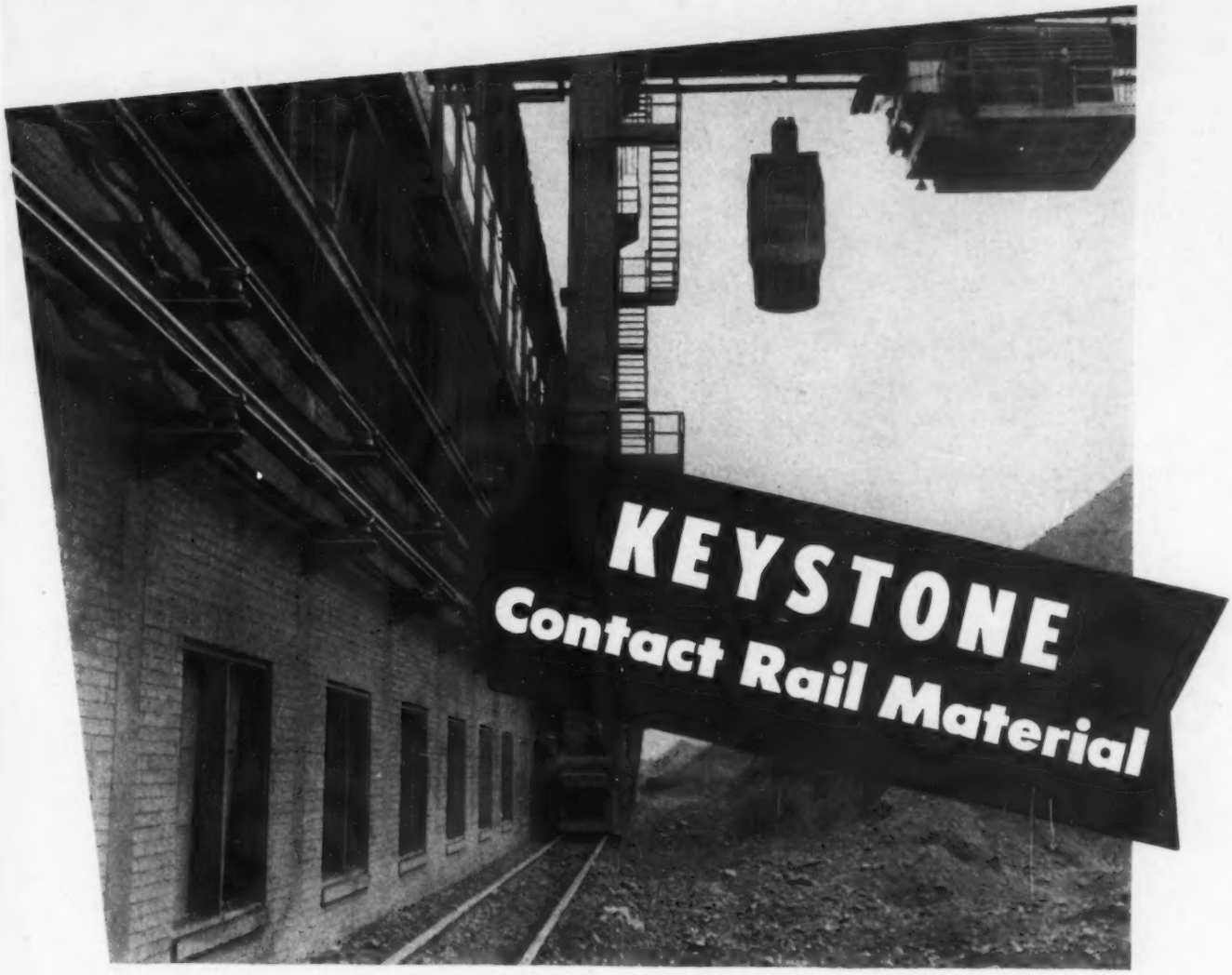
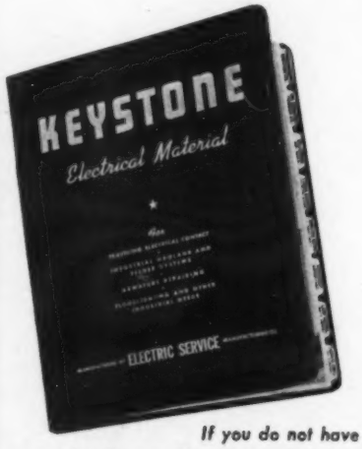
Simply mark the reference number on the coupon, complete your address data and return to us.





If you do not have this catalog in your files please ask for a copy

KEYSTONE contact rail material provides the constant contact that insures reliable transmission of power to your cranes, conveyors and other electrical industrial hoisting and hauling systems. A complete line is available utilizing either rails, angles, wire or bars as conductors and including numerous types of insulators for either under-running or over-running operation. You may also select from many types of current collectors including Junior, Universal and Pantagraph styles and contact rail shoes. These products are widely used in most large steel mills, being thoroughly proven in service. The complete catalog, illustrated, will be very helpful to all interested in the construction or maintenance of cranes or feeder systems.

ELECTRIC SERVICE MANUFACTURING CO.

TRANSPORTATION, POWER AND INDUSTRIAL PRODUCTS

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1946 was an outstanding year in Coke Oven Plant activity

The by-product coke industry's reconversion program has included a large number of contracts for rehabilitating old coke-plant facilities and for expanding existing plants.

Improvements incorporated in the new ovens include "saddle-brick" wall construction, self-sealing doors, waste gas recirculation with underjet design and wider acceptance of double collecting mains.

In addition to the coke oven construction, current work includes modernization of by-product and benzol recovery equipment, and a novel development in hydrogen sulfide recovery from coke-oven gas for the production of sulfuric acid. A plant of the latter type is now under construction. Koppers Company, Inc., Koppers Building, Pittsburgh 19, Pa.

LOOK TO THE FUSE LEADER FOR PRODUCTION PROGRESS

WARE HI-LAG *Renewable* FUSES

Double Fibre Bridge Assembly Increases Strength 10 Times

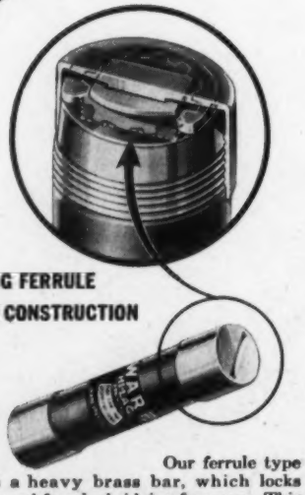
WARE HI-LAG Fuses have the strongest, most rigid knife blade assembly ever designed in fuses. The two heavy fibre bridges are supported by sturdy brass brackets which add greatly to the strength of the assembly. These bridge supporting brackets are attached to the copper knife blades and contact the entire end of links so that current flows through the brackets as well as the blades over a large area. Another reason for WARE HI-LAG Fuse's cool operation.

Perfect alignment is always maintained in this knife blade assembly with links centered in casing. The links are quickly and easily replaced or removed by loosening the nuts and slipping in or out.

Start using WARE HI-LAG Fuses today! Make them Standard Equipment for greatest economy and satisfaction. Investigate *now!*

Write for Brochure giving details of all the COOL FACTS, sizes and prices

APPROVED BY UNDERWRITERS' LABORATORIES



HI-LAG FERRULE FUSE CONSTRUCTION

Our ferrule type fuse has a heavy brass bar, which locks into open end ferrule, bridging fuse case. This bridge locks link to prevent twisting and cap tightens on new center contact. No sagging washers or twisted links to cause overheating.

WARE Brothers 4450 W. LAKE ST.·· CHICAGO 24, ILL.

(*Continued from page 132*)

istries of such steels useful in assisting the maintenance of uniformity of their products. Of particular significance is the triple alloy steel tubing of the 8630 type which finds use in the aircraft industry because of its strength, ease of forming and ready weldability.

There also has been considerable return to popularity of the standard prewar alloy steels. Of the carburizing types, the 4600 series appears to be growing in demand, not only because of the properties developed, but because distortion as a result of heat treatment is minimized. For heavy duty carburized parts the 4300 and 3300 steels are generally employed. In the direct hardening grades, the 3100, 4600, 8600 and 2300 steels enjoy popularity, with the nickel-chromium-molybdenum 4340 steel being widely used for highly stressed parts of heavy cross-section.

STAINLESS STEELS

The demands for stainless steels continue to increase. It is estimated in trade circles that 1946 production will exceed or at least equal that of 1945. Of all stainless steel produced, the chromium-nickel types comprise more than two-thirds of the total.

Particular popularity is enjoyed by the two grades, AISI 302 and 304, containing about 8 per cent nickel. Both types are well suited to assembly by welding, but type 304 because of its low carbon content is better suited for welding without subsequent heat treatment. Increased interest is also exhibited in stainless steel containing molybdenum (type 316), because of its ability to withstand certain specific corrosion conditions. This particular alloy finds increased use in chemical, paper and related industries.

The need for materials to withstand the exceptionally high temperatures of jet and gas turbine engines has given great impetus to the development of so-called "super-alloys" for high temperature service, and as the demand for such engines becomes popular, a considerable market for these materials may be anticipated.

Industry is paying increasing attention to the engineering characteristics of alloy irons. Of note are the high strength gray cast irons containing 1½ to 5 per cent nickel, which are being used in Diesel engine crankshafts and cylinder liners and for aircraft piston rings. Strengths up to 100,000 lbs per square inch are being obtained.

Nickel plating continues to be an increasing part of expanding platers' activity. Developments in high speed nickel plating baths, permitting the deposition of metal at higher current densities, have increased production capacities of shops with limited tank sizes and floor space. Bright nickel processes are being augmented by "semi-bright" deposits of good buffing qualities to reduce polishing and buffing costs.

—1-E-5—

INDUSTRIAL TRUCKS MOVE MATERIAL QUICKER

▲ Acquired to complement an existing system of material handling by overhead cranes and manually-moved small trucks, two storage battery-powered lowlift platform trucks, each of 6,000 pounds capacity, have revolutionized material movement and placement in the plant of the Erie Foundry Company, Erie, Pennsylvania, manufacturers of forge shop machinery.

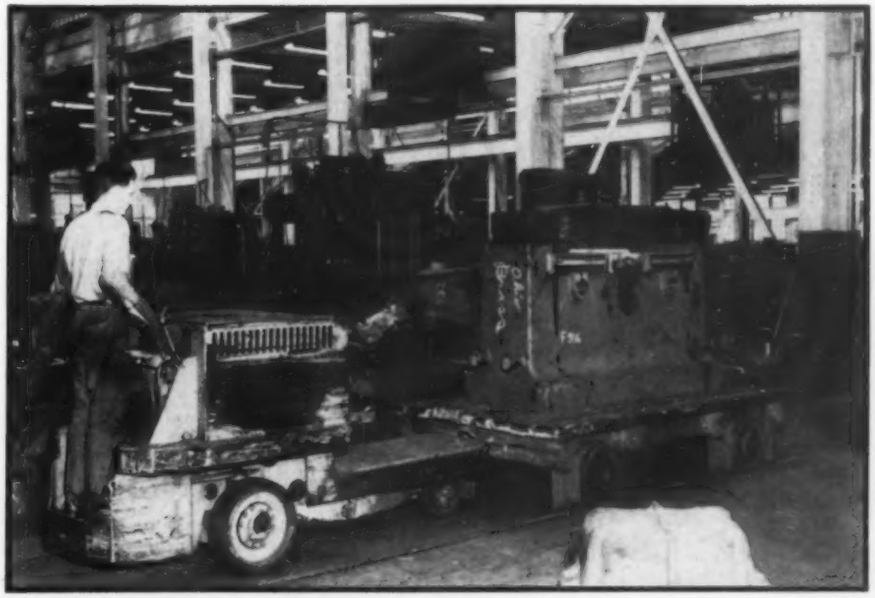
The Erie Foundry Company's plant consists of four bays, all serviced by overhead cranes. In the south bay there are three cranes, a 150-ton, a 20-ton and a 10-ton; in the north bay there are four cranes, of 110-ton, 40-ton, 20-ton and 15-ton capacities; the west and east cross-bays house 50-ton and 15-ton cranes, respectively. It is in these areas that the construction of the huge pieces of machinery that constitute the plant's products is undertaken.

Due to expansion of, and additions to, its plant in the early years of the war, some material in process flow at the plant of the Erie Foundry Company had been moved into and through production by manually-operated trucks, or by the system of overhead cranes. For the large pieces, too heavy for movement by hand, the latter method was found to be wasteful of time, while production also suffered. Movement from the main high bay on the north side to an adjacent point in the west bay — a distance of perhaps some 50 or 75 ft in a straight line — had to be accomplished by movement of a crane to the west bay and transfer to the crane system there. Other cranes, serving the north bay, were prevented from operating while the movement was under way.

With the installation of the battery-powered trucks, pieces too heavy for manual movement, which consequently had been moved by crane as described above, were easily moved between bays by means of convenient cross aisles. This resulted not only in a saving in time, but also in the elimination of the costly tieing up of the crane systems, the latter being reserved for the extremely heavy loads.

In addition, small parts and pieces are moved into position adjacent to

A 15-ton load, on transfer car, is moved in traverse of processing points, towards final assembly, by means of storage battery-powered lowlift platform truck.

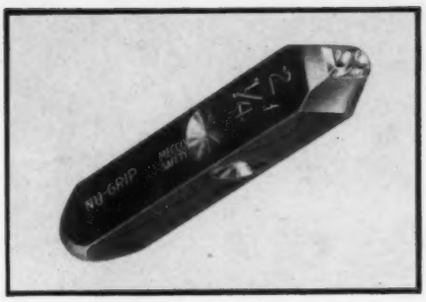


work areas, or into temporary or "hold" storage, in bin-skids or on flat-top skids. Patterns and billets of metal are moved on trailers which are either pushed, or pulled, by the platform trucks, sometimes while the latter are carrying a load on the platform. Some of the raw material, brought to the plant in freight cars or over-the-road motor trucks, is set down or placed on skids in the receiving area, and removed to the first operation either by platform truck or by crane. Parts, or pieces, weighing up to about 7,000 lb, are moved into the shipping area, packaged, and taken into outward shipment by means of the trucks as well.

—1-E-6—

SAFETY STEEL STAMPS FEATURE POSITIVE GRIP

▲ An entirely new safety steel stamp design, designated as "Nu-Grip," is announced by the M. E. Cunningham Company. The newly designed stamp is made of the company's "Mecco" safety steel, and incorporates all the advantages of positive grip at a more economical cost.



A countersunk hole on each of the four sides assures the operator a positive grip.

These stamps feature a countersunk hole on all four sides of stamps. The design of the hole has been engineered an exact contour to assure the operator of a positive grip, and a "feel of security" when stamps are struck by severest hammer blows. Grip holes are positioned on stamps at exact center point for perfect balance.

The safety stamps are built for long service life, and are available in all standard sizes from $\frac{1}{32}$ in. up to and including 1 in. Characters are engraved on standard heavy duty blanks, and therefore, are adaptable for all kinds of stamping applications, including marking of tough alloy steels.

—1-E-7—

CANADIAN ORE MINE NOW LARGE PRODUCER

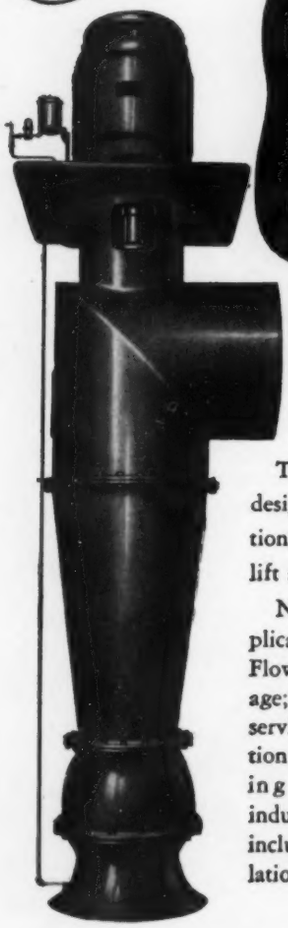
▲ Steep Rock Iron Mines, Ltd., shipped 826,144 tons and stock-piled 167,654 tons — a total of 993,798 tons — of high grade iron ore from the company's Steep Rock range during the 1946 season. Production goal for the 1947 season is 1,250,000 tons. The Canadian iron range, after its first season of full operation, thus assumes the status of the first new large producer of high grade iron ores in the Lake Superior district in many years.

To date all production has come from one open pit located on what is known as the B orebody, but the opening of additional orebodies will be relatively simple. To bring the first into production was a gigantic 3½ year task, requiring the creation of a complete industrial community in new country, with the construction of all living and working facilities

PEERLESS PUMPS

PEERLESS Hydro-Foil PUMPS

Move huge volumes of water against low and medium heads

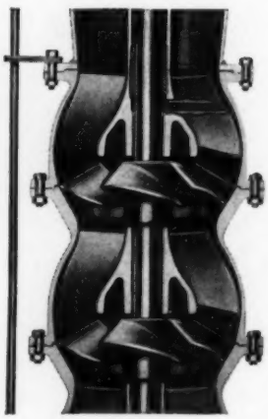


To rapidly move and remove maximum amounts of water

— PEERLESS MIXED-FLOW PUMPS

The most modern principles of aero and hydro-dynamic design are embodied in Peerless Mixed-Flow pump construction, attaining new high efficiencies in large volume water lift and lowering overall maintenance and pumping costs.

Numerous successful applications of Peerless Mixed-Flow Pumps include: drainage; sewer and flood control service; de-watering; irrigation water diversion; flooding of agricultural lands; industrial and process work including condensers, circulation of liquors, etc.



PEERLESS MIXED-FLOW PUMPS

CAPACITIES: UP TO 220,000 G.P.M.

Cutaway view of Mixed-Flow multi-stage pump impeller and bowl construction revealing high efficiency impellers used for more economical lift.

PROPELLER TYPE PUMPS

Peerless pumps, embodying the Hydro-Foil principle, are also available in the propeller type and are capable of handling identical capacities of the Peerless mixed-flow pump. Request Bulletin B-143 on design, construction and application data of these two outstanding types of Peerless Pumps, for large-volume pumping.

PEERLESS PUMPS

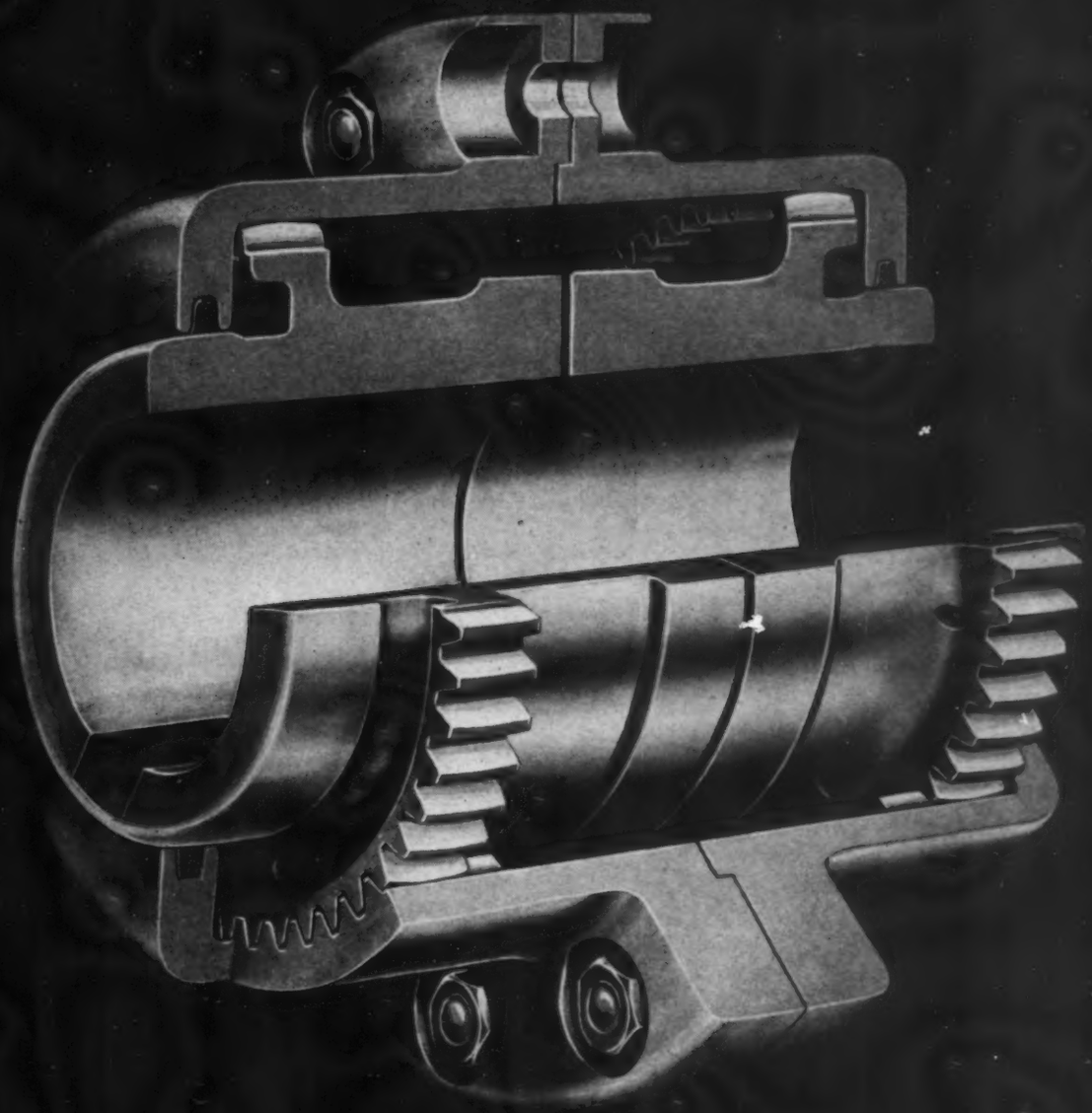
PEERLESS PUMP DIV. FOOD MACHINERY CORP.

Los Angeles 31, Calif.; Canton 6, Ohio; Quincy, Ill.

FACTORY BRANCHES: ARDMORE, PA.; DECATUR, ILL.; ATLANTA, GA.; DALLAS, TEXAS.

DISTRIBUTORS PRINCIPAL CITIES

POOLE



A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUES

FLEXIBLE COUPLINGS

POOLE FOUNDRY & MACHINE COMPANY

WOODBERRY, BALTIMORE, M

from roads to buildings, and calling for the diversion of a river system, the pumping out of a lake of important proportions, and the removal of large areas of over-burden. This work, it is pointed out, constituted a large part of the pre-production work required to open all of the mines at Steep Rock.

Development plans of Steep Rock Iron Mines, Ltd., contemplate immediate expansion of open-pit production from the existing mine, and immediate and intensive exploration of a second orebody. The aim of the company is to bring annual output from the second mine to a figure greater than annual tonnage from the orebody now in production.

ROLL TURNING TOOL PROVES COST SAVER

▲ Kennametal, Inc. has developed a line of broad-nose tools for turning cast iron rolls up to 90 Scleroscope. Preliminary performance reports indicate major savings in production costs can be effected with these new tools. For example, a roll that required 25 hours for rough grinding was turned with two 8 in. tools in 8½ hours.

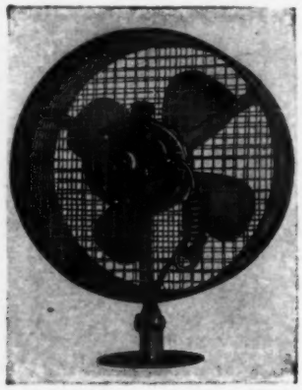
These roll-turning tools comprise solid Kennametal Grade K6 blades, securely held in position on an accurate surface of the supporting shank by a clamp aud serrated, advanceable back-up plate, each of heat-treated steel.

The blade has four cutting edges that may be used in succession before any sharpening is required. Then it can be reground time and again (long sides only), and advanced each time to cutting position, until 2/3 of the Kennametal has been utilized.

These tools are available in four standard cutting widths: Style 4RT—4 in.; Style 6RT — 6 in.; Style 8RT — 8 in.; Style 10RT — 10 in.

—1-E-8—

IS HEAT SLOWING UP YOUR WORKMEN?



TRUFLO CRANE CAB FANS
For cooling interiors of crane cabs and other confined areas. Adjustable both horizontally and vertically. Four blade type, 12 and 18 in. sizes

Keep Them COOL with TRUFLO FANS

TRUFLO PORTABLE COOLING FANS
Easily portable. Help keep efficiency high where work is hottest. 12 to 36 inch diameters.

Production suffers when workmen are overheated. Steps begin to drag, efficiency falls.

Now, when speedy production is vital, Truflo Fans can help keep your workmen on their toes. All Truflo Fans are designed and built correctly to put fresh cool air *in large volumes* exactly where it is needed. Perfectly-balanced shafts and blades give more air per h.p. . . . strong steel frames stand up longer under hard use . . . rugged wire guards protect men against injuries.

All of the following types can help beat the heat, keep production moving in your plant. Write for illustrated literature.

PORTABLE COOLING FANS
CRANE CAB FANS • WALL FANS
EXHAUST FANS • BLOWERS
ROOF VENTILATING FANS
PENT HOUSE FANS

TRUFLO FAN COMPANY
554 MAIN ST., HARMONY, PA.

HOT WASHING WATER AVAILABLE ANYWHERE

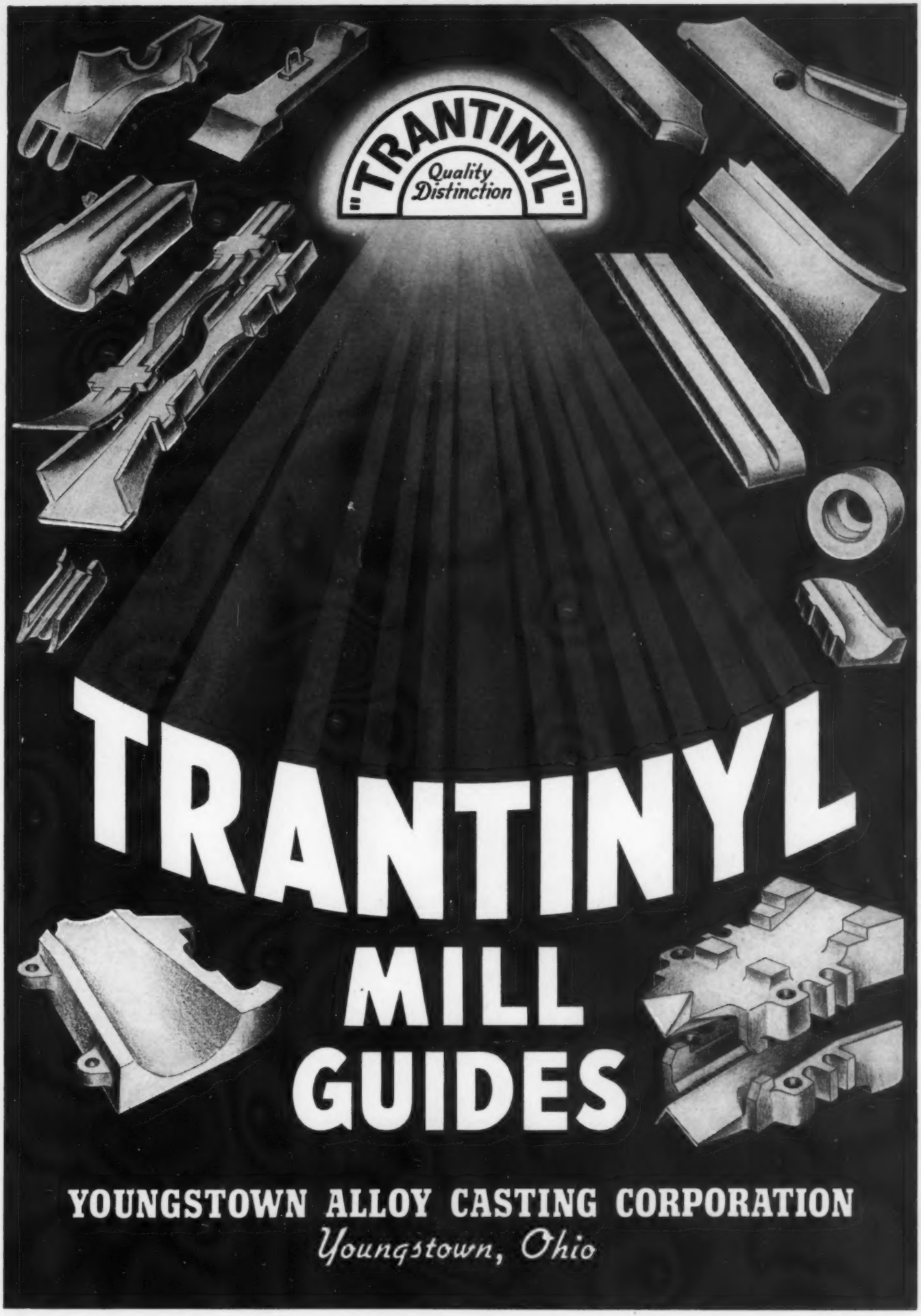
▲ To provide hot water at remote points for showers and wash basins is one of the ever present nuisance-problems of the larger factories and mills. Simply tap in on a steam pipe with the new Sarco Company steam and water mixer, which is designed to eliminate the necessity of piping hot water long distances.

The smallest washroom can easily house this steam and water mixer, streamlined to a bare 26 in. length, 5 in. width at the head. The thermostat, built-in and liquid-filled, insures automatic, sensitive temperature control, as set by key. Hot water capacities are: 200 gal per hr, temperature rise of 50-120 F, with a steam pressure of 75 psi.

—1-E-9—

LEWIS FOUNDRY SELLS SHEET MILLS ABROAD

▲ Lewis Foundry and Machine division of Blaw-Knox Company has announced receipt of orders for sheet mills and accessory equipment from the Societe Anonyme d'Ougree-Marihaye of Ougree (near Liege), Belgium; and the Compagnie des


TRANTINYL
Quality Distinction
TRANTINYL
MILL
GUIDES
YOUNGSTOWN ALLOY CASTING CORPORATION
Youngstown, Ohio

Forges d'Audincourt & Dependances, Paris, France.

The contract placed by the Belgian firm covers one 3-high sheet breakdown mill, 32 by 20 by 62 in., and two 2-high finishing mills, 30 by 54 in., for the production of carbon and silicon steel sheets. Included are the necessary drives and auxiliary equipment for the mills, plus one pair and two pack heating furnaces.

The Paris firm has ordered one 3-high sheet breakdown mill, 32 by 20 by 62 in., and two 2-high finishing mills, 30 by 54 in., together with the necessary auxiliary equipment for the production of carbon and silicon steel sheets.

RADIO FREQUENCY HEATING

By B. F. RECTOR

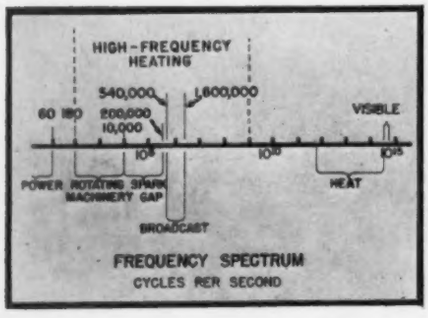
Westinghouse Electric Corporation

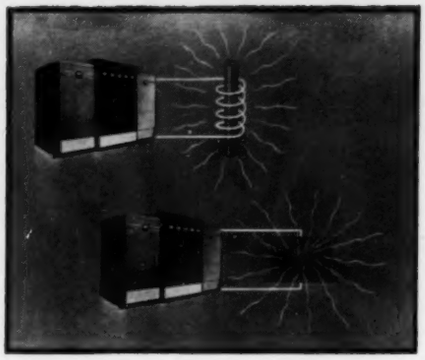
▲ From limited use a few years ago, radio frequency heating has spread today to many fields of industry. In the field of metal working it is used for soldering, brazing, annealing and hardening.

According to common usage, radio frequency heating implies the use of alternating currents ranging from 200,000 cycles a second up to hundreds of millions of cycles a second. Or, to use the "shorthand" of the trade, from 200 kilocycles (kc) up to hundreds of megacycles (mc), for one kilocycle equals 1000 cycles, and one megacycle equals 1,000,000 cycles. The term "high frequency heating" is more loosely used, to include not only these frequencies but also frequencies from 180 cycles to 200,000 cycles.

Power for high frequency heating in the 180 to 200,000 cycle range is usually furnished by motor generator frequency changers or spark gap generators. For most radio frequency heating applications, power is supplied by vacuum tube generators. This is the device with which we are concerned here, for it is primarily responsible for most of the revolutionary advances in modern heating technology.

Frequencies for R-F heating begin at 200,000 cycles per second; extend well into millions of cycles per second.





Upper diagram: R-F energy transmitted through the coil induces a similar current in the rod (workpiece). Heat results from resistance of the workpiece. Lower diagram: Workpiece is a non-conductor (dielectric) between two electrodes. R-F energy in electrodes sets molecules of workpiece in motion, generating heat.

The principle structural elements of radio frequency generators are (1) an eletronic rectifier, which takes the incoming a-c power and delivers a suitable high voltage direct current, and (2) oscillator tubes and associated circuit elements which change the direct current to alternating current of the desired radio frequency. In addition there are coils or electrodes for applying the radio frequency current to the work in such a way as to produce the desired heating effect, and also various associated control devices.

The generating equipment has essentially the same function as, and bears a close resemblance to, the transmitting unit of a radio broadcasting station. In fact, much of the early experimental work in R-F heating was done with regular broadcasting equipment. Because of the experience gained in broadcasting, the actual generation of R-F power for heating has been a lesser problem, and engineers have been able to concentrate on the many new problems involved in the precise heating of workpieces of a wide variety of shapes, sizes and materials.

Two fundamentally distinct methods of applying R-F power are employed — by induction when the workpiece is of a material which is a conductor of electricity, and dielectrically, when the workpiece is a nonconductor (dielectric).

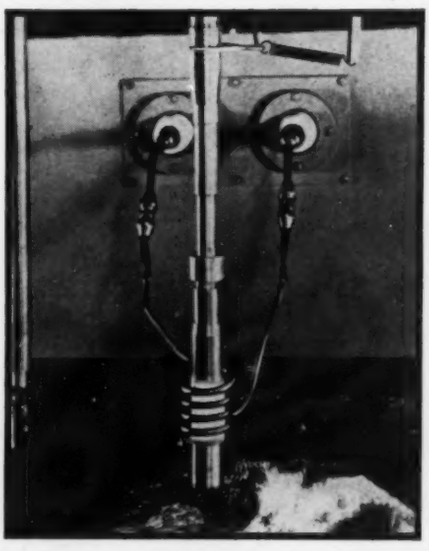
The advantage of precise depth control is shown in such applications as shaft hardening. Here the bearing surface must be made as hard as possible, but the core of the shaft must remain tough and resilient. The problem is to heat the surface to a predetermined depth and temperature, so quickly that little heat is transferred to the interior of the shaft.

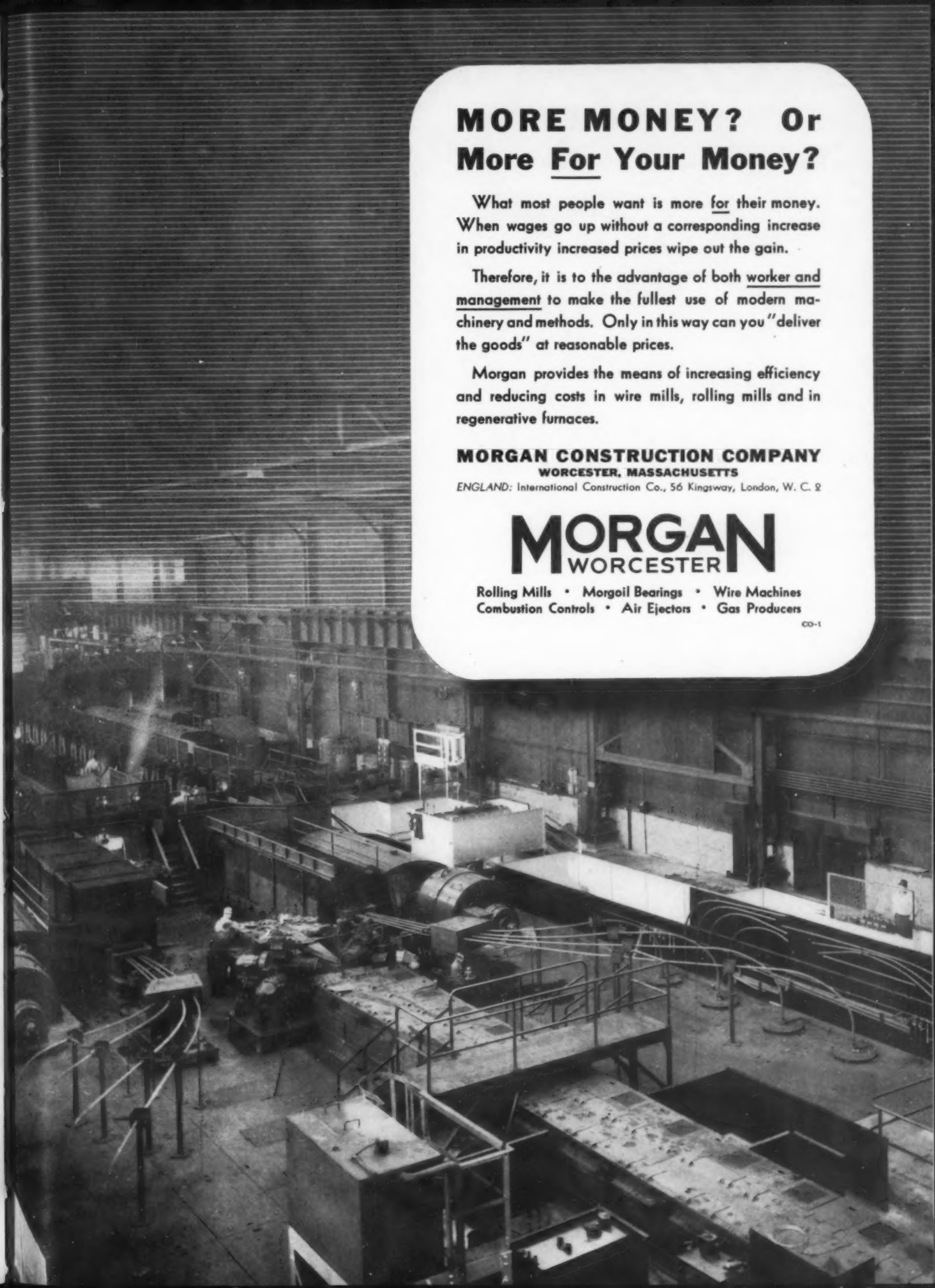
For the induction heating engineer, this problem is simple. The shaft is properly positioned within the inductor coil of a radio frequency heater, current is passed through it, and the surface metal becomes red hot over the desired area so quickly that the heat has no time to wander off where it might do harm instead of good. When the correct hardening temperature is reached, the power is automatically shut off and the hot surface quenched in water or oil.

Shaft hardening and similar operations can also be performed by passing the shaft through a coil at a uniform rate of speed, such that the time of passage through the coil is just enough to allow the shaft's surface to reach the correct hardening temperature. The piece is automatically quenched by sprays of water from nozzles just below the inductor coil.

—1-E-10—

Shaft is passed through the work coil at a predetermined speed. At the right instant, the power is automatically shut off and the shaft drops into the quench.





MORE MONEY? Or More For Your Money?

What most people want is more for their money. When wages go up without a corresponding increase in productivity increased prices wipe out the gain.

Therefore, it is to the advantage of both worker and management to make the fullest use of modern machinery and methods. Only in this way can you "deliver the goods" at reasonable prices.

Morgan provides the means of increasing efficiency and reducing costs in wire mills, rolling mills and in regenerative furnaces.

MORGAN CONSTRUCTION COMPANY
WORCESTER, MASSACHUSETTS
ENGLAND: International Construction Co., 56 Kingsway, London, W. C. 2

MORGAN
WORCESTER

Rolling Mills • Morgoil Bearings • Wire Machines
Combustion Controls • Air Ejectors • Gas Producers

CO-1

GRAY RECORDER CHARTS PROVIDE EASIER READING

▲ Bailey Meter Company has recently introduced recorder charts printed in neutral gray. This makes it easier for operators and supervising engineers to read the charts because of the greater emphasis given the various colored records by the neutral background. The new charts are especially valuable on recorders installed where lighting is poor or where it is impossible to get a clear view of the chart. The improvement in legibility is especially apparent with the dark colored recorder ink normally used, such as red, blue and green.

These charts are accurately made from wax engraved plates insuring perfect, correctly spaced, concentric divisions. The center holes are punched simultaneously with the printing to insure accurate centering. A special trimming process provides full size charts while eliminating errors caused by eccentric charts.

—1-E-11—

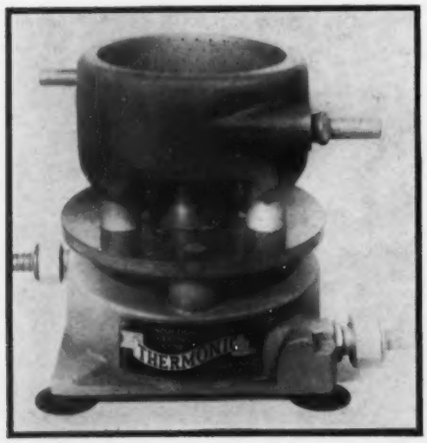
QUENCH RING SIMPLIFIES HEAT TREATING ROTATION

▲ A compact, hydraulic rotary spindle and quench ring, combined in a single unit, is the latest of the growing line of accessories now available from the Induction Heating Corporation. Designed for use with any type of induction heating equipment, this unit simplifies the handling and heat treating of parts requiring rotation during the heating cycle and subsequent quenching in position.

The work piece is located on a spindle, which is actuated by a water driven turbine, fed through standard hose and nozzle attachments at the base of the unit. The speed of rotation is readily controlled by varying the flow of water. This combination unit is portable and can easily be moved from one coil to another. This portability eliminates the inherent restrictions of permanently installed spindles, usually electrically operated, which limit operations to one particular coil position. Wherever the operator places the unit, rubber suction cups hold it firmly in position.

—1-E-12—

This combination unit is portable and can easily be moved from one coil to another.



1947 BEARING DEMAND GREATEST IN HISTORY

▲ Peacetime reorganization of industrial plant machinery and a vast backlog of unfilled orders for consumer goods in 1947 will create one of the greatest demands in history for anti-friction ball and roller bearings, according to H. O. Smith, secretary of the Anti-Friction Bearing Manufacturers Association.

In scores of types of productive machinery, the number of anti-friction bearings has trebled or quadrupled to meet the need for higher speeds and greater strength and accuracy, Mr. Smith said in a year-end review. Begun under the stress of war, this trend is continuing at an expanding rate.

Many industries which in 1940 were moderate bearing consumers are now major markets and are absorbing a greater share of the ball and roller bearing output. Typical of such industries are textiles, earth moving equipment, machine tools, farm equipment and railroads.

With the automotive builders, these industries alone accounted for a major share of the $220,000,000 in anti-friction bearing production in the past 12 months, it was pointed out. In the textile field, demand for new synthetic fabrics and greater output of all textiles is forcing a general changeover to higher speed ball and roller bearing equipped machinery in hundreds of plants for the first time.

In 1940, with the exception of crack luxury trains, most railway passenger cars and virtually all freight cars, rolled on plain friction type bearings. Today, approximately 3,000 new passenger cars on order are being equipped with roller bearing journals to provide smoother riding and to eliminate hot box delays. In addition, anti-friction bearings are being installed on large numbers of express freight cars for the first time.

Added to these expanded applications, there is increased demand for additional ball and roller bearings in farm machinery, household appliances, electrical and power equipment. The new sealed ball bearing, which is lubricated for its lifetime, is now used in many types of electrical household equipment.

An industrywide strike which called out 70 per cent of all anti-friction bearing workers plus isolated walkouts and strikes in supplier industries forced the sharpest cutback and leaves a heavier backlog in 1947 among the 35 major producers, Mr. Smith explained. Barring industrial strife, the production in the coming year will be at an unprecedented peacetime high, he added.

—1-E-13—

WATER TREATMENT NOW SIMPLIFIED AT LOW COST

▲ For an industrial establishment having corrosion or scale water troubles in hot water or cooling water systems, whether it uses 13,000 or 1,000,000 gallons per month, Calgon, Inc. has developed a new series of "Micromet" feeders by which the chemical can be fed into the water lines with simplicity and low cost.

The feeders comprise an extension of the first "Micromet" feeder, developed last year for domestic use. The new series consists of large-type feeders holding up to 20, 50 or 100 pounds of "Micromet" at one charge. The chemical dissolves slowly, rate 25 per cent per month, so that only that much of the initial charge needs to be renewed each month. It is a modification of Calgon, which is being successfully used in more than 600 municipal water systems and in many industrial installations to prevent lime scale and control corrosion.

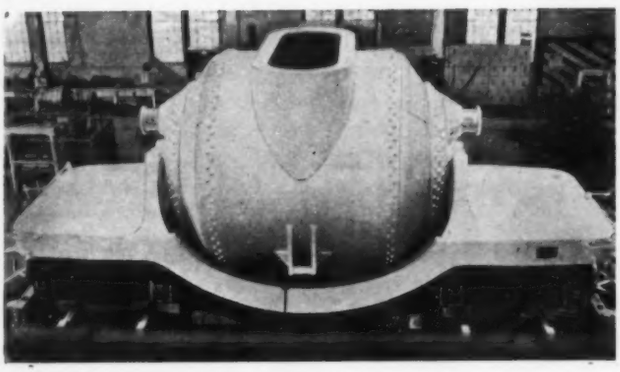
The amount of chemical required — and the size of feeder — depend on the type of water trouble encountered and the amount of water to be treated. For corrosion the 50-pound feeder, for

PENNSYLVANIA ENGINEERING CORP.

NEW CASTLE, PENNA.

Engineers - Contractors - Erectors

Builders of Blast Furnace and Blast Furnace Equipment



Heat Retaining Hot Metal Car

Bells
Hoppers
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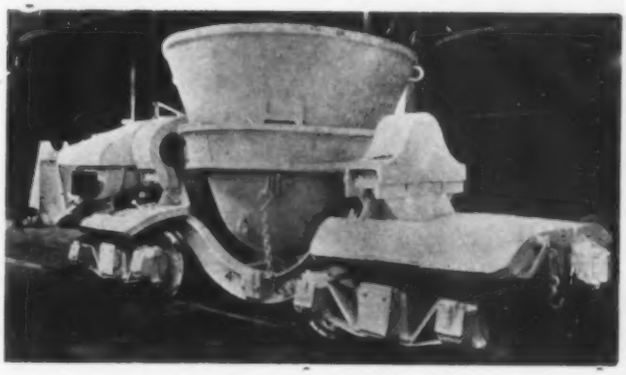
Bustle Pipes
Tuyere Jackets
Bosh Bands
Hot Blast Stoves
Stove Fittings
Hearth Jackets
Dust Catchers
Gas Washers
Skip Cars
Skip Inclines
Cast Houses
Ore Bins
Gas Mains
Blast Mains
Columns
Valves
Burners
Hot Metal Cars
Cinder Cars



Blast Furnace Slag Car

Blast Furnaces Repaired, Dismantled, Enlarged, Modernized

Complete facilities within our own organization enable us to give prompt and efficient service. In addition to our engineering and erecting departments, our facilities include a machine shop, plate shop, structural shop, welding shop, forge shop and pattern shop.

example, will handle up to 150,000 gallons of water per month. For hard waters producing lime scale it will handle up to 300,000 gallons. The larger feeder will handle up to 1,000,000 gallons of scale-producing water per month. The smaller type feeders will handle as low as 3,000 gallons per month. The feeders are simple in design, inexpensive and have no upkeep cost.

The Micromet water treatment, which inhibits scale and corrosion without attempting to soften the water fully, is thus made available to all types of commercial and industrial establishments — hotels, hospitals, restaurants, dairy plants, textile and leather plants, schools, colleges, many types of manufacturing plants, laundries, office buildings — in fact, wherever hot water or cooling water systems are a problem. The huge cost that business pays for corroded and scaled pipes can now be eliminated, according to chemists of the Pittsburgh concern, which has been engaged in solving industrial water problems since 1926.

—1-E-14—

STRAY CURRENT CONTROL PREVENTS COSTLY DAMAGE

▲ The development of a new stray current control system, said to offer a solution to the problem of how to prevent the damaging effects caused by electrolytic action on underground pipe installations, including gas mains, oil and water lines, conduits, telephone cables and similar items, is announced by the Cook Research Laboratories. It is conservatively estimated that preventable electrolysis causes more than $50,000,000 damage annually in the United States in oil, gas and water industries alone.

Dr. J. R. Downing, director of research at Cook Research Laboratories, stated that "engineers have recognized the habits of this electrolytic disease in pipe systems for many years, but, until the present development, it is believed that no satisfactory means of so minimizing its effects has ever been developed."

Electrolysis occurs when stray current in pipe lines seeks to escape through the surrounding soil, and in so doing touches off a reaction in which metal from the pipe is removed. This action is not to be confused with rusting, where weather and soil conditions play a far greater part in causing the corrosion.

Electrolysis of gas, water and oil mains is especially severe in areas where there is an overhead trolley wire or third rail, and the car tracks are utilized as a return circuit to the power house. Because these tracks are not the best conductors, and due to varying potentials in the rail, the current sometimes leaves the tracks and enters the ground. It is known as stray current in such cases. Using the surrounding soil then, as a conduction path, it travels through the earth to a neighboring pipe line. Here it continues to follow the pipe for some distance. Then due to a varying potential or some obstruction to its flow, the stray current leaves and either attempts to return to the overground rail or to enter another underground line.

At these points of current emission from the pipe, especially where the soil is damp, the presence of electrolytic action causes such deplating of metal that eventually the pipe wears through. To prevent this, the stray current control system has been developed.

The stray current control system may be described as a current and voltage-sensitive device, operating jointly on a high current contactor. The contactor is activated by the current and voltage-sensitive device, the functioning of which depends on the amount of current or potential present in the pipe. This means when stray current tends to leave the pipe, the contactor will close, thereby connecting the pipe and rail with a solid metallic bond on which the current may travel harmlessly rather than by damaging electrolytic action through the soil. Conversely, the contactor will open instantaneously when the current tends to flow in the opposite direction, that is, from rail to pipe. In this manner the contactor will prevent the system from becoming a back-path for more stray current, which, if permitted to flow uncontrolled, would result in further electrolysis of the pipe.

A standard telephone-type pole cable terminal mounting will be used to house the stray current control system. The unit is 26 inches high and 8 inches in diameter. This does not include the contactor, which is a separate unit, the size of which is not standard and will vary depending on the maximum amount of current to be allowed through the system.

—1-E-15—

FLOWMETER FLOATS HAVE ROTATING MOTION

▲ Fischer and Porter Company, manufacturers of variable area type flow metering instruments heretofore called "Rotometers," have recently announced adoption of the trade-mark name "Flowrator" to designate the product of its manufacture.

The first use of the former name "Rotameter" appears to have been made about 40 years ago by one of the early European manufacturers of variable area type flow rate indicators using transparent tapered tubes. This manufacturer utilized plumb-bob shape metering floats having bias notches cut into the float heads to impart a rotating motion. The rotation improved the stability of the metering floats and eliminated most of the vertical and horizontal oscillation previously encountered. In view of this rotation the name "Rotameter" was used even though it did not describe any essential function or operating requirement of the instrument and led to the erroneous impression on the part of many who first heard it, that the instrument measured rotation. As specialists in the manufacture of the variable area flow meters for indicating, recording, controlling and integrating flow rate, Fischer and Porter Company have developed the new "bead-guide" metering tube and other methods of float stabilization more positive than the rotation feature. The rotating float has therefore been abandoned and the old name "Rotameter" has lost all significance as applied to the company's product.

—1-E-16—

ENCLOSED SAFETY SWITCH IN QUANTITY PRODUCTION

▲ Trumbull Electric Manufacturing Company realizes one of its first postwar aims in announcing the "Type D" enclosed safety switch. The new switch design has been coordinated with modern principles of straight line production and the use of newly developed tools and assembly meth-

ods to bring about quantity production at low cost. It is rated at 30 amperes and is compactly contained in a box that measures only 4½ in. wide × 6⅛ in. long × 3¼ in. deep. The overall effect is, in reality, an entirely new conception of switch appearance to harmonize with any surroundings.

A uniquely designed handle gives front operation, and its attached triple duty spring takes up any loose tolerance in the switch. The spring also provides a flexible connection to movable contacts, as well as a seal between handle and cover. The switch is designed so that the pivoting lever may be padlocked in the "off" position to prevent opening of the switch or cover by an unauthorized person.

Available in 2 pole, 125 volts; 3 pole solid neutral, 125/250 volts; 3 pole solid neutral with meter twist-out 125/250 volts; and 3 pole solid neutral, 125/250, 230 volts, a-c.

—1-E-17—

NEW CRANE SIGNAL ADDS TO SAFETY OF WORKMEN

▲ Mills in increasing numbers are equipping cranes with a highly effective Lintern crane signal. It provides safety for crane operators when lubricating their cranes and for other workmen when making repairs or checking equipment. It enables all cranemen on the same runway to know at all times the condition of the other cranes.

The signal consists of two "Glowlites," one having a red lens and the other a green. The red signal warns that the crane should not be moved. When the crane is operating, the green signal is used.

Husky stud bolts that cannot drop out hold lens assembly securely to mounting bracket. Adjustable receptacles lessen vibration, simplify wiring, and are adjustable to the lamp center required by each individual job. While lamp changes are being made, a heavy steel chain, attached to the two parts, protects lamp from breakage.

—1-E-18—

FOR MORE INFORMATION

on any item appearing in the NEWS SUPPLEMENT, use the coupon on page 132.

Book Reviews....

▲ The 1947 edition of the National Electrical Code is a collection of rules governing the installation, and to a certain extent, the use of electrical equipment. Its purpose is to reduce the hazard from electrical fires and electrical accidents and it does this by specifying the exact manner in which electrical materials, devices, fittings and appliances shall be both originally installed and later maintained. A strict compliance with the National Electric Code will produce an electrical installation which may be deemed reasonably safe from electrical fires or accidents.

Presented for the first time in convenient desk reference size, 6 by 9 inches, this 408-page volume is uniform in size and format with the other four volumes of the National Fire Codes also published by the NFPA. Published by the National Fire Protection Association, 60 Batterymarch Street, Boston, Massachusetts. Price: $2.00.

▲ The National Electrical Manufacturers Association has just published a comprehensive analysis of the revisions made in the 1940 National Electrical Code. These revisions are incorporated in the 1947 edition of the code, copies of which will soon be made available by the National Board of Fire Underwriters. The new National Electrical Code contains more new material than does any previous edition. There are two completely new articles, one on electric welders and one on machine tools and eight articles have been entirely rewritten. In addition, many changes of considerable importance have been made throughout the code.

The analysis is in the form of a booklet, 4½ by 6¾ inches, containing 144 pages. Single copies are priced at 50 cents each and 30 cents each for ten or more copies. The booklet is published by the National Electrical Manufacturers Association, 155 East 44th Street, New York 17, New York.

▲ The latest and most complete collection of technical and operating data on the metallizing process are contained in the fourth edition of the METCO Metallizing Handbook, published by Metallizing Engineering Company, Inc., Long Island City 1, New York.

Metallizing technique and finishing procedure, complete data on corrosion resistance, specific gravity, hardness, bond strength, tensile strength and relative shrink are included.

This 86-page, pocket size handbook presents both practical and technical aspects of the metallizing process in complete detail. Price $2.00.

▲ A loose-leaf book, "Manual for Heat Treating Services", has just been published. It is designed to help manufacturers get the full advantages of commercial heat treating services by informing them of the range of heat treating services, thus enabling them to intelligently specify their needs.

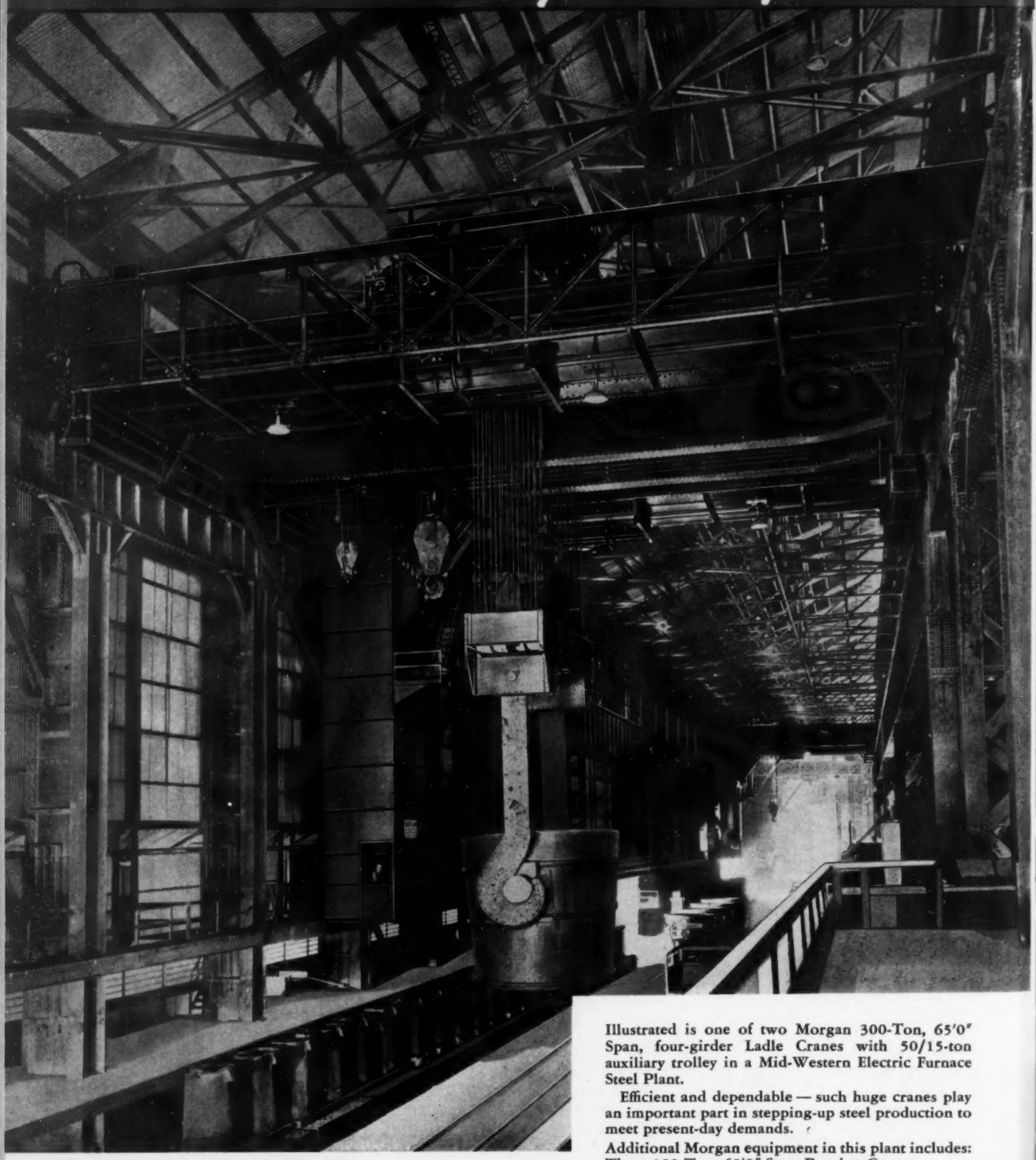
This book contains several sections which deal with subjects such as steel selection, machinability, grinding, relationship between heat treatment and design, basic principles of heat treating, a general description of the various heat treatments, non-ferrous heat-treating and brazing, cold treating, preparation and care of steel surfaces before, during, and after heat treating, inspection and testing, how to order heat treating, and a glossary of metallurgical terms.

It is compiled and published by the Metal Treating Institute, 420 Lexington Avenue, New York 17, New York, and priced at $4.00.

▲ The Askania Regulator Company has published a two volume book on basic design problems titled "Analysis and Design of Translator Chains." The study reduces all designs to basic elements and establishes methods for solving complex problems of instrumentation. A type of shorthand which is usable on any typewriter permits the description of involved mechanisms in extremely simple symbols which in turn can be used in building up variations for individual solutions. It is, so far, the first rational approach to a systematic solution of electromechanical problems.

The book is available from the Askania Regulator Company, 1603 South Michigan Avenue, Chicago, Illinois, at a cost of $5.00, postage prepaid.

Engineering



MORGAN 300-TON, 65′0″ SPAN POURING CRANE

Illustrated is one of two Morgan 300-Ton, 65′0″ Span, four-girder Ladle Cranes with 50/15-ton auxiliary trolley in a Mid-Western Electric Furnace Steel Plant.

Efficient and dependable — such huge cranes play an important part in stepping-up steel production to meet present-day demands.

Additional Morgan equipment in this plant includes:
Three 150-Ton, 65′0″ Span Pouring Cranes.
Two 150-Ton, 80′3″ Span Hot Metal Charging Cranes.
Two 200-Ton, 63′0″ Span Universal Type Ingot Strippers.

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Personnel News . . . .

Buford M. Stubblefield, recently appointed general superintendent of the Campbell works of Youngstown Sheet and Tube Company has been named manager of the Chicago district of the same company. Born in McLean, Illinois on September 13, 1892, Mr. Stubblefield graduated from the University of Illinois in 1915, and went to Youngstown to take a position with the American Tar Products Company. In 1916 he started to work for Youngstown Sheet and Tube Company at the Campbell works coke plant. In 1920 he became assistant superintendent of the coke plant, and in 1923 was made superintendent. In March 1929 he was made superintendent of the coke plant and blast furnaces at the Campbell works. He was made superintendent of the Brier Hill works in 1943, and subsequently was named assistant general superintendent at Campbell.

John S. Stanier was appointed general superintendent of flat rolled and tubular mills at the Campbell, Ohio, works of the Youngstown Sheet and Tube Company. Mr. Stanier's association with the steel industry began in 1912 with vacation employment at the West Penn Steel Company, Brackenridge, Pennsylvania. In 1917, he entered Lehigh University, but left to join the army, where he served with the 11th Field Artillery, Sixth Division, for 18 months of World War I. After the war he re-entered Lehigh, graduating in 1923. In 1924 he served as night superintendent of the West Penn Steel Company and was made metallurgist the following year. From this position he was made assistant general manager. In 1928 he joined the Newton Steel Company of Newton Falls, Ohio, as special mill representative and later was appointed assistant to the vice president in charge of operations. In 1933 he went with the Youngstown Sheet and Tube Company as superintendent of the sheet mills at the Brier Hill plant, which position he held until his appointment as superintendent of the cold strip mill at the Campbell plant. In November 1936 he was appointed superintendent of the cold strip and sheet mills. In 1942 he was appointed superintendent of the hot and cold strip mills of the Youngstown Sheet and Tube Company located at the Campbell works.

W. H. Yeckley was appointed general superintendent of the Brier Hill works of the Youngstown Sheet and Tube Company, Youngstown, Ohio. Mr. Yeckley first went to Youngstown Sheet and Tube in May 1937 as a test engineer in the fuel division — coming from the Lorain plant of the National Tube Company. Mr. Yeckley served in this capacity until January 1938 when he was appointed assistant superintendent of the open hearth department of the Brier Hill plant. In July 1940 he was promoted to superintendent of the same division and in 1943 was made assistant superintendent of the sheet and cold strip mill and later become superintendent of the Brier Hill works.

C. J. Daley, assistant superintendent of the sheet and cold strip mill, was appointed superintendent of the cold strip mill of the Youngstown Sheet and Tube Company, Youngstown, Ohio.

J. E. Finnie, assistant superintendent of the hot strip mill of Youngstown Sheet and Tube Company's Brier Hill works was appointed superintendent of the hot strip mill.

William G. Caples was appointed manager of industrial relations for the Inland Steel Company, Indiana Harbor, Indiana. Mr. Caples joined Inland Steel a year ago upon his return to civilian status following war service with the U. S. Army during which he had an outstanding record as a combat officer in the Pacific.

During the past year he has served as staff assistant in the company's industrial relations activities.

Dr. Robert Hollenbeck Aborn has been appointed assistant director of the research laboratory, United States Steel Corporation, at Kearny, New Jersey. A native of Battle Creek, Michigan, Dr. Aborn graduated from Grinnell college, Iowa, in 1918, and in 1920 won a bachelor of science degree and in 1925 a degree of doctor of science at Massachusetts Institute of Technology.

Employed in the blast furnace department of Bethlehem Steel Company in 1920, Dr. Aborn was later employed at the Watertown arsenal in 1923 and in 1925 returned to conduct research at MIT. In 1928 he became an instructor at the engineering school at Harvard University, leaving that post to join the Kearny laboratory of U. S. Steel in 1930.

Harry E. Lorenz has been appointed purchasing agent of Carnegie-Illinois Steel Corporation. It was also announced that **C. H. Baringer** and **F. G.**

BUFORD M. STUBBLEFIELD

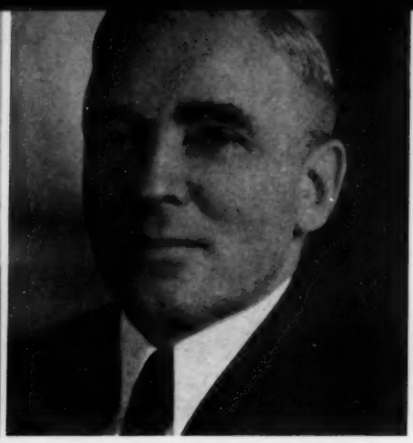
JOHN S. STANIER

W. H. YECKLEY

C. J. DALEY

J. E. FINNIE

HARRY E. LORENZ



CARL W. LITTLER

JULIUS E. GRAF

Buchheit have been made assistant purchasing agents.

Mr. Lorenz, a native of Chicago, Illinois, started his service with United States Steel Corporation Subsidiaries in 1922 as a buyer in the Illinois Steel Company. At the time of the formation of Carnegie-Illinois Steel Corporation, he was made office manager of the Chicago office. In 1944, he was made assistant purchasing agent of the Chicago district, the position he held until his present appointment.

Mr. Baringer was first employed by Carnegie-Illinois in 1937 at the Canonsburg plant. In 1942, he was transferred to the purchasing department of the Pittsburgh office and in 1946 was made chief clerk, the position he held until his present appointment.

Mr. Buchheit started his service with Carnegie-Illinois in January, 1946, after seventeen years' experience with the National Tube Company as a buyer.

Carl W. Littler, chief engineer of Jones and Laughlin Steel Corporation and its subsidiaries, retired at his own request effective December 31, 1946. Mr. Littler, who received his polytechnical and university education in his native Switzerland, came to the United States in 1902 and joined the engineering staff of Westinghouse Electric and Manufacturing Company. Three years later he went into the engineering department of National Tube Company, and in 1907 transferred to the Carnegie Steel Company's engineering organization where he remained until 1920. During World War I, Mr. Littler was engaged in chemical developments connected with coke by-product plants. From 1920 to 1925 he was chief engineer of the Semet Solvay Company, directing the building of by-product plants in the United States and England.

Mr. Littler came with Jones and Laughlin in 1925 as chief engineer at the Aliquippa works. In 1929 he was made the chief engineer of the corporation and from 1941 to his retirement he has been chief engineer of all Jones and Laughlin subsidiaries as well.

Julius E. Graf was appointed chief engineer of Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania. He has been assistant chief engineer of the corporation for the past six years and succeeds **C. W. Littler,** retired.

Mr. Graf was born in Pittsburgh, is a graduate of Carnegie Institute of Technology and prior to his coming to Jones and Laughlin was for many years in the engineering division of the American Sheet and Tinplate Company and the Carnegie-Illinois Steel Corporation.

From June 1945 to June 1946, Mr. Graf was in Germany serving as chief engineer of the metals section in the economics division of the American Military Government.

Thomas M. Chalmers as vice president in charge of operations of the Tennessee Coal, Iron and Railroad Company retired January 1. Mr. Chalmers will serve as an operating consultant to the vice president, engineering and operations, U. S. Steel Corporation of Delaware, Pittsburgh.

Mr. Chalmers, a vice president of the southern United States Steel subsidiary for nearly 17 years, has been in charge of all the Tennessee company's mining and manufacturing operations since May 1, 1943.

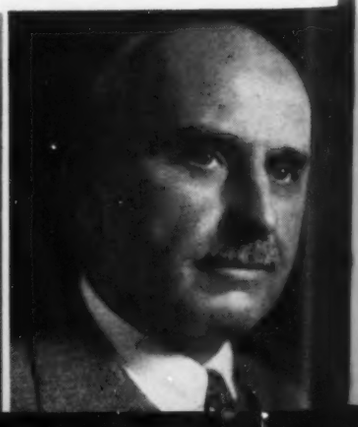
Born in Saltcoats, Scotland, near Glasgow, in March 1881, Mr. Chalmers first joined U. S. Steel in 1906 at the Duquesne, Pennsylvania, works of Carnegie Steel Company. Mr. Chalmers came to Birmingham and entered the employ of the Tennessee company on May 11, 1908 as a brickmason at Ensley works. In June 1913, Mr. Chalmers was appointed assistant superintendent of the Fairfield coke works. After continuing until October 1918 when he was promoted to superintendent, he was promoted in December 1926 to

THOMAS M. CHALMERS

ARTHUR V. WIEBEL

A. B. HASWELL

DR. ANSON HAYES



the position of general superintendent of Fairfield coke works and the Fairfield sheet mill.

A vice presidency covering the coke works and sheet mill was created in February 1930 and Mr. Chalmers was promoted to the position. His responsibilities were broadened in August 1935, when he became vice president in charge of manufacturing operations, and again in May 1943 when mining operations also were placed under his direction as vice president in charge of operations.

Arthur V. Wiebel was appointed vice president in charge of operations for Tennessee Coal, Iron and Railroad Company, and **A. B. Haswell** was appointed vice president in charge of engineering for Tennessee Coal, Iron and Railroad Company.

Mr. Wiebel, a native of Cumberland, Maryland went to Birmingham recently from Pittsburgh where he held operating responsibilities as assistant to the vice president, engineering and operations of the United States Steel Corporation of Delaware. Mr. Wiebel was graduated from Carnegie Institute of Technology with the degree of mechanical engineer in 1928.

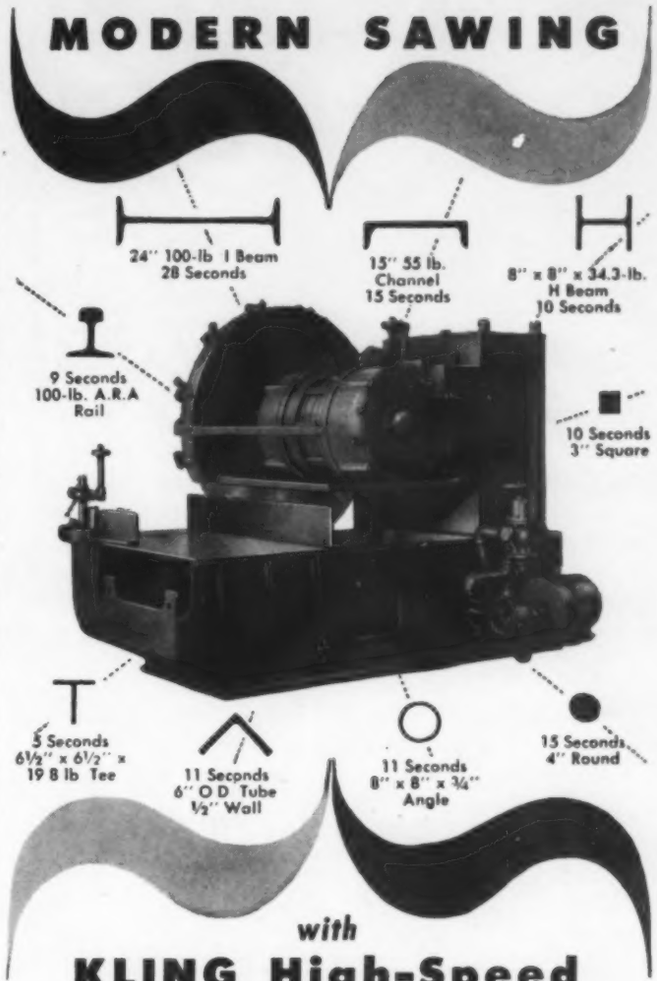
In 1933 he joined U. S. Steel as an estimator in the engineering department of Carnegie-Illinois Steel Corporation's Youngstown, Ohio plant. After occupying positions of responsibility in engineering and operations in Carnegie-Illinois' plants In the Pittsburgh area during the next seven years, Mr. Wiebel became chief engineer in the company's Pittsburgh district on March 1, 1940. He was promoted to assistant to vice president, engineering and operations of the United States Steel Corporation of Delaware on December 1, 1940.

Mr. Haswell, a resident of Birmingham since 1912, was born and reared in Hardinsburg, Kentucky. He earned his bachelor of science degree in mechanical engineering at the University of Kentucky in 1911 and completed post-graduate work there with the degree of mechanical engineer in 1914. He began his business career as a draftsman for the Atlanta Steel Company, Atlanta, Georgia in June 1911.

Mr. Haswell entered the employ of the Tennessee company in October 1912 as a detailer in the engineering department of the company's manufacturing division. He worked his way through the positions of squad leader, draftsman, chief draftsman and chief engineer and became assistant to vice president, engineering and construction, in February 1929.

Dr. Anson Hayes was elected a vice president of the American Rolling Mill Company. Dr. Hayes has been with Armco for 18 years. He graduated from Drake University, Iowa, received his master's degree from Iowa State College and his doctor's degree from the University of Chicago. He then held the chair of chemistry at Iowa State College until he joined Armco. His first connection with the company was in 1928, as chief chemist of the research staff. He was made director of research in 1929.

H. P. Munger, former special metallurgist at the Campbell plant of the Youngstown Sheet and Tube Company, has been appointed superintendent of the company's tin finishing department at Indiana Harbor. Mr. Munger, a graduate of Georgia Tech, joined Youngstown June 27, 1945. He was an industrial fellow at Mellon Institute in Pittsburgh on



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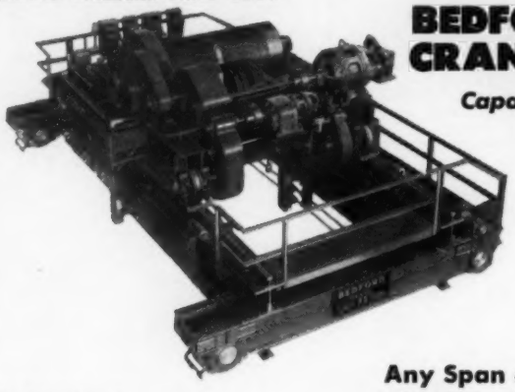

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research for two years; metallurgist, research laboratory of the American Rolling Mill Company, Middletown, Ohio, seven years; assistant chief metallurgist and superintendent of electro tin plating for Republic Steel Corporation for two years; and plant manager for Van der Horst Corporation at Olean, New York two years.

Clarence G. Roll was appointed purchasing agent of the Ashland, Kentucky, division of the American Rolling Mill Company. Mr. Roll began his long association with Armco as a timekeeper in the company's Zanesville, Ohio, plant in 1919. He spent several years in personal relations work and later became a supervisor in the hot mill department. In 1927 he was made assistant supervisor of purchasing and the following year he was appointed supervisor of purchasing and stores at the Zanesville plant. He transferred to the general purchasing department at Armco's general offices in Middletown, Ohio, in 1945 and then to Ashland, where he became acting purchasing agent in August 1946.

George A. Stout, formerly district manager, Trumbull Electric Manufacturing Company, Cincinnati, Ohio, is now central district manager, Federal Electric Products Company, Cincinnati, Ohio.

Howard C. Kaeff has been appointed general superintendent, strip and tin plate plant, Indiana Harbor works, Indiana Harbor, Indiana, Youngstown Sheet and Tube Company, Youngstown, Ohio. Mr. Kaeff was superintendent, cold reduction department, Fairfield, Alabama, Tennessee Coal, Iron and Railway Company, Birmingham. His first association with the steel business was in Gary, Indiana, in the hot strip mills and finishing department of Carnegie-Illinois Steel Corporation, Pittsburgh, a subsidiary of United States Steel Corporation, New York.

G. R. Schreiner was appointed assistant director of advertising for the United States Steel Corporation of Delaware. Mr. Schreiner, formerly advertising manager of Carnegie-Illinois Steel Corporation, succeeds **Reese H. Price,** who has resigned. **Robert J. Wilcox** was appointed acting advertising manager of Carnegie-Illinois, to succeed Mr. Schreiner.

C. H. Lenhart, formerly assistant general superintendent, Kaiser Company, Inc., Fontana, California, has been promoted to the position of general superintendent.

E. F. Donatic, formerly assistant superintendent of general maintenance, Kaiser Company, Inc., Fontana, California, has been promoted to the position of superintendent of general maintenance, succeeding **B. A. Shrive** who has been forced to resign due to ill health.

Vere B. Browne, a pioneer in the development and manufacture of magnetic and stainless steels, retired on January 1, 1947 as vice president and technical director of the Allegheny Ludlum Steel Corporation. Mr. Browne, whose career dates back to 1909 when he came to the United States from Nova Scotia to become chief chemist of the Allegheny Steel Company at Brackenridge, Pennsylvania, served as vice president for 16 years and technical director for three years. He will become an honorary vice president and will be available as a consultant. **Frank B. Lounsberry,** vice

(*Please turn to page 157*)

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JANUARY, 1947

(1) Industrial Exhausters

Available is a new bulletin describing Buffalo industrial exhausters. Ratings for all models are published in full. (3576). Buffalo Forge Company.

(2) Sewage Pumps

A revised bulletin is available giving construction details, dimensions, installation and operational data on vertical and horizontal, self priming sewage pumps, sewage ejectors and single suction sludge pumps. (964-D). Buffalo Pumps, Inc.

(3) "How to Pour Babbitt Bearings" . . . .

. . . . is the title of a wall card that is available giving the steps necessary to secure good, tightly lined bearings. Instructions are printed on card stock suitable for hanging in shop. Joseph T. Ryerson and Son, Inc.

(4) Pressure Castings

"Meehanite — The Metal for Pressure Castings" is available to you. Describes and illustrates a variety of applications of Meehanite castings to pressure work in cases where high pressures are required. Also states five primary reasons why this casting material is successful. (10). Meehanite Metal Corporation.

(5) Potentiometers

"'ElectroniK' Strip Chart Potentiometer" is subject of new catalog. This new development is described and illustrated. The continuous balance operating principle and resulting advantages are featured with constructional details. (15-10). Brown Instrument Company.

(6) Data Book

Grinding wheel selection tables, rules for more efficient operation, instructions for easy ordering, suggestions, shortcuts and illustrations are included in a new grinding wheel data book. (127). Simonds Abrasive Company.

(7) Chain Hoists

Available is a new bulletin covering a complete line of spur geared (high speed) and differential chain hoists, together with their army type low headroom Timken equipped trolley hoists. Catalog is filled with tables, section and photographic views of the various products manufactured, including the line of I-beam trolleys. (G588). Chester Hoist Company.

(8) Pneumatic Transmission

"Pneumatic Transmission of Instrument Readings over Long Distances" is the title of a technical article that is available to you. The article has been prepared by the company engineers and is complete in its subject coverage. Diagrams, sketches, formulas and tables are included. (B59-2). Brown Instrument Company.

(9) Leather Packing Guide

A new hydraulic and pneumatic leather packing guide has just been issued. The booklet contains important packing data covering usage, types, sizes and tables. Catalog has been prepared to fit your filing cabinet. (A-49). Alexander Brothers.

(10) Welding Procedure Sheets

Available to you are welding procedure sheets covering the use of Ampco bronze electrodes. These are entitled: "Procedure for Welding Silicon Bronze" and "Welding Procedure for Beryllium Copper." The procedures discuss the recommended electrode, polarity and current, preparation, preheat, and detailed technical data on the welding of the base metal. (D-2311). Ampco Metal, Inc.

(11) Bucket Bulletin

A new catalog on two-line lever arm buckets for rehandling, general purpose, hard digging, dredging, and industrial uses. Features include an explanation of how to select a clamshell bucket of the proper size, weight, and type; definitions of standard bucket terms; and data on standard equalizer bar arrangements for overhead cranes. (2076). Blaw-Knox Company.

(12) "Pour-Rite" Ladles

A bulletin is available describing the new Whiting "Pour-Rite" ladles. One of the outstanding features of this new advanced design, all welded ladle is that the trunnions are welded to channel-shaped members permitting air-circulation. Other features are also described and illustrated. (FY-144). Whiting Corporation.

(13) Diesel Engine

A bulletin is available describing the Worthington type DH diesel engine. Applications and installations are illustrated and described in detail. Details of construction are shown by photographic views with descriptions. Specifications are included. The engine is a vertical, four-cycle, modern design, prime mover suitable for exacting and severe service. (S500-B42A 464RP). Worthington Pump and Machinery Corporation.

(14) Control Relays

A catalog is available on alternating and direct current relays which consist of small, solenoid operated switching units for industrial applications that require compact miniature contactors of unfailing dependability. Included are sizes, prices, type numbers and diagrams of each type of relay available. (700). Allen-Bradley Company.

(15) Fiberglas

A new edition of Fiberglas electrical insulation materials catalog is available. Contains complete information about the many forms of material available and indicates where and how to use this material to obtain its many advantages. Describes the resistance to high temperature, moisture and acid; favorable space factor and high tensile strength; and the effectiveness of Fiberglas. Owens-Corning Fiberglas Corporation.

(16) Ramming Mix

A booklet is available on "Magnehearth," describing this scientifically grain-sized ramming mix, which has a high magnesium content, assuring maximum open hearth

and electric furnace bottom life. This material may be used not only for the forming of complete bottoms but for sub-hearths over which are sintered in dead burned magnesite grains. (Magneharth). General Refractories Company.

(17) Fluid Drive

Reprints of a technical article on "Applying Fluid Drive in Industry" by G. V. Edmonson, staff engineer, hydraulic coupling division, American Blower Corporation, are available to you. The article, appearing in the Iron and Steel Engineer for March 1946, discussed the transmission of industrial power through fluid drive. Its use for chargers, conveyors, drawbenches, cranes, as well as other a-c and d-c equipment is completely and thoroughly discussed. American Blower Corporation.

(18) Rotary Compressors

A bulletin on rotary compressors and vacuum pumps is available. The bulletin describes the ease of installation because the compressors do not require large, heavy foundations with relation to capacity when compared with other types of compressors. These compressors have a minimum of moving parts, only three: rotor, bearings, and blades. (C-5). Fuller Company.

(19) Silica Firestone

A bulletin is available describing Buckeye silica firestone which holds heat longer and provides greater savings in fuel. The bulletin tells how you can obtain economical soaking pit operation through the use of this material. (15-B). Cleveland Quarries Company.

(20) Generator Sets

A bulletin is available describing H-VW-M generators that are qualified for many types of service, including electroplating, anodizing, and other industrial uses. The bulletin tells about the core-ventilated laminated armatures of non-aging silicon steel; low-loss laminated fields; generous sleeve-type bearings with oil-rings; and wide voltage range or stable voltage characteristics. (G-101). Hanson-Van Winkle-Munning Company.

(21) Cam Lock Valves

A bulletin is available describing McKee "Kam-Lock" valves for the protection of gas-fired equipment from damage resulting from pressure failure. The booklet tells how these simple, rugged valves are unaffected by vibration, how they are activated by pressure failure alone, and are not dependent upon electric current for operation. (M-300). Eclipse Fuel Engineering Company.

(22) Oil Burners

Available to you is a catalog telling why performance of hundreds of furnaces has been improved with Hauck proportioning oil burners. The book describes the variable nozzle orifice method of controlling air and oil which gives wider range of turndown than is possible with any other proportioning system. (407). Hauck Manufacturing Company.

(23) Revolving Heaters

The modern system of industrial plant heating is discussed in a catalog on revolving unit heaters. Included in the bulletin are design and construction; engineering data; mounting heights and coverage; dimensions and weights; typical specifications; wiring details; installation planning; and piping details. (HR-4). L. J. Wing Manufacturing Company.

(24) "Fundamentals of Annealing . . . .

. . . . . Low Carbon Steel" is the title of a reprint of an article which appeared in the November 1946 Iron and Steel Engineer, available to you. The article presents the results of experiments conducted at the Case School of Applied Science under the direction of the physical metallurgy department. Lee Wilson Engineering Company.

(25) "Ingot Heating . . . .

. . . . with Modern Soaking Pits" is the title of a reprint of an article which appeared in the Iron and Steel Engineer, January 1946, available to you. The paper emphasizes the performance of the circular pit and covers the search for improved ingot heating through modern pit design. The article was prepared by N. W. Richardson of the Salem Engineering Company.

(26) "Control of Vibration"

. . . . is the title of an article by Alvin W. McKaig, division manager of Fabreeka Products Company, which was reprinted from the September 1946 issue of the Iron and Steel Engineer. The reprint, which is yours for the asking, describes why many equipment failures are in reality fatigue failures which have been accentuated by vibration. It tells how such failures may be reduced through the proper use of damping materials. Fabreeka Products Company.

(27) Balanced Proportion Bearings

"Development of Balanced Proportion Roller Bearings for Rolling Mills" by Paul Haager, assistant chief engineer, Timken Roller Bearing Company, which appeared in the November 1946 issue of the Iron and Steel Engineer, is available in reprint form. The article gives the experience and research that was combined in the evolution of improved bearing designs which have shown greater capacity and rigidity Timken Roller Bearing Company.

(28) Contact Material

A contact catalog and data book on silver-graphite contacts and silver-tungsten contacts is available to you. (Contact catalog and data book No. 12). Stackpole Carbon Company.

(29) Bearing Bronze

A bulletin is available to you telling the physical characteristics of Olds bearing bronze, and how experience has shown that operating and maintenance costs go down on machinery and equipment using this material. Olds Alloy Company.

(30) X-ray Units

Two interesting booklets are available on General Electric X-Ray units. "The Story of X-Ray," and "Industrial Applications of the X-Ray." General Electric X-Ray Corporation.

(31) Specification Selector

The Sterling specification selector lists the proper grinding wheels for hundreds of operations. Sterling Grinding Wheel Division of the Cleveland Quarries Company.

(32) Roll Grinders

The complete story, including sizes and capacities, of the type TT roll grinder's precision production ability is given in a bulletin that is available to you. (113). Farrell-Birmingham Company, Inc.

(33) Sling Calculator and Data Book

A sling calculator and a sling data book are available to you which will aid you in the selection and use of correct size and design of slings. The calculator enables you to determine safe working load for your Roebling slings on every class of lift. May be used for wire rope or "Flatweave" slings. The sling data book contains a wealth of material on wire rope slings. (A899 and Calculator). John A. Roebling's Sons Company.

(34) Electro-Silvery

. . . . is the title of a book on high silicon pig iron for steel plant and foundry. This book is valuable addition to the executive's file of technical data. Scores of photographs, seven oil paintings, and interesting informative text tell of special methods of processing and casting high silicon pig iron. Keokuk Electro-Metals Company.

(35) Broaching Machine

A bulletin describing vertical pull down broaching machines is available. It illustrates 21 tool, fixture and machine installations for internal and external broaching operations. The bulletin also shows standard detent tool holders and automatic pullers. (25000). Oilgear Company.

(36) "Mechanical Principles . .

. . . . of 'Gorilla' grip electrical connectors" is the title of a booklet available to you. Described and illustrated are cutaway models and schematic drawings, as well as a factual analysis of the mechanics involved. National Electric Products Corporation.

(37) Non-Metallic Bearings

A bulletin describing non-metallic bearings, the laminated resin textile product that has proved so successful for roll necks and other bearing positions in steel mill service, is now available. These bearings, which have been in use for many years and which have established enviable performance records in rolling mills throughout the country, are especially designed for water lubrication. Case studies presented in the bulletin point to power savings running as high as 35 per cent. Joseph T. Ryerson and Son, Inc.

(38) Gear Couplings

A catalog is available to you on the new Waldron Series "A" flexible coupling. The catalog includes: Standard gear coupling description and ratings; heavy duty mill type coupling description and ratings; mill motor type ratings; floating shaft type ratings; Jordan type ratings; shear pin type coupling ratings; and many other types of couplings. (57). John Waldron Corporation.

(39) Conveyor Screens

A new bulletin has been issued describing and illustrating Robins Eliptex screens. The Eliptex, according to the bulletin, employs a unique elliptical motion with three separate components. Included are specific applications for dewatering, heavy-media dewatering, and other applications are also defined in detail. (111 A). Robins Conveyors, Inc.

(40) Unit Heaters

A new booklet gives details and capacity tables on the different models of "Grid Unit Heaters" with high test cast iron heating sections. Features of design and construction are described and an explanation of the one piece cast heating sections that withstand steam pressures up to 250 lb, withstand high corrosive atmospheres, and resist corrosion. D. J. Murray Manufacturing Company.

(41) Arc Welding Periodical

The "Arc Welding News" is a periodical magazine which can come to you if you are interested in welding. The magazine is well designed and contains much information and data which will be of use to all maintenance men. Hobart Brothers Company.

(42) Metal Cutting

A catalog on "Marvel" metal cutting saws is available to you. The catalog includes a description of the relative speed of the blade through both the cutting and return strokes when reciprocated by "simple crank" and by "crank lever" action. A description of the ball bearing construction is also included. (C43). Armstrong-Blum Manufacturing Company.

(43) Mechanical Chipping

Dedicated to executives who are concerned with steel production and costs, an attractively prepared publication is waiting your action. The book asks the question whether you are still chipping billets by hand, while your competitors are using two, three, four and five "Billeteers," and tells you how one large steel company is now operating nine of these time-saving machines. Bonnot Company.

(44) Power Transformers

A bulletin is available giving a summary of the power transformers built by this manufacturer. Included are design and construction features. Each page of this bulletin has detailed information of the various components of these transformers. (1046). Pennsylvania Transformer Company.

(45) Motor Starters

A new set of bulletins describing synchronous motor starters for 600 volts or less and also for 2300 to 4600 volt service is available. These bulletins give complete descriptions as well as tables on ratings, dimensions, etc. (1075B, 1076B, 1077A and 1078A). Electric Controller and Manufacturing Company.

(46) Diaphragm Valves

Complete details of the "Valvarator" line of diaphragm motor valve construction is included in a new bulletin available to you. The catalog tells how this valve line is an outgrowth of the recording-controller "Flowrator" instrument. (70A). Fischer and Porter Company.

(47) Water Conditioning

A new instruction booklet, entitled "Allis-Chalmers Water Conditioning Chemicals and Equipment" written for the guidance of power plant operators is available. The booklet touches upon the importance of feedwater control, the care of testing equipment, obtaining samples, test procedures, and carries handy reference tables to assist in reporting results. (28 x 6385). Allis-Chalmers Manufacturing Company.

(48) Cars for Steel Mills

A catalog is available describing a wide range of cars for steel making plants. This catalog gives technical data on cars such as dump cars, ingot cars, and ore cars used in steel plants. (72E). Pressed Steel Car Company, Inc.

(49) Fans

A new bulletin is available on "Durco" corrosion-resistant fans for exhausting acid and other corrosive fumes. The bulletin gives complete engineering data including dimensions and capacities of the five standard sizes of fans made by this company. Typical applications are shown by drawings, together with information on the type of drives used. (1102). Duriron Company, Inc.

(50) Thermit Welding

Reprints of "Thermit Welding in Steel Plant Maintenance" prepared by J. H. Deppeler, chief engineer, Metal and Thermit Corporation, will soon be available. This article appeared in the September, 1946, Iron and Steel Engineer. The article describes the thermit process of welding and a number of applications in industry. Metal and Thermit Corporation.

(51) Flexible Couplings

An engineering catalog on flexible couplings is available. Technical information, specifications, features of construction, tables showing dimensions and ratings, and illustrations of applications are included. Thomas Flexible Coupling Company.

(52) Lubrication Oil Filter

A bulletin is available describing the "Puri-Filter," a combination of the "Uni-Matic" Oil purifier and the "Filcron" filter. The bulletin explains why with this filter diesel lubricating oil can be maintained clean and dry. (D-1). DeLaval Separator Company.

(53) Protective Clothing

A new booklet on industrial protective clothing is available. The booklet tells of the new Goodrich products in this field, pictures each garment, describes its functions in industry, and relates the method of construction and materials used to guarantee maximum service. (12000). B. F. Goodrich Company.

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(54) Self-Aligning Couplings

A book prepared by engineers for engineers is available. Condenses complete technical data on Fast's self-aligning couplings: theory, design, lubrication principles, types, complete dimensional information, how to figure size, how to order, and installation and operation instructions. Bartlett-Hayward division, Koppers Company, Inc.

(55) Motor Drive

A bulletin is available describing V * S drive, which is an all-electric adjustable speed drive for a-c circuits. The booklet explains the operation principles and shows typical applications with complete data on each. (311). Reliance Electric and Engineering Company.

(56) Vertical Pumps

A new bulletin is available on "Peerless Vertical Close-Coupled Turbine Pumps." It is devoted in its entirety to describing and illustrating the specialized application of turbine pumps to industrial installations. The bulletin is illustrated with cutaway views of the pump, schematic diagrams of suggested methods of pump installation. Details of pump engineering, construction and operation are included. (B-159). Peerless Pump division, Food Machinery Corporation.

(57) Roller Hearth Furnaces

A bulletin is available describing prepared atmosphere roller hearth furnaces for ferrous and non-ferrous bars, tube and strip. Characteristics of these furnaces, practical and economical means of minimixing decarburization and preventing scale, and the proportioning burners are described. Included is furnace operating data. (SC132). Surface Combustion Corporation.

(58) Gas Pulsation

"The Effects and Corrections of Gas Pulsation Problems" by Foster M. Stevens, principle research engineer, Fluor Corporation is the title of a technical bulletin available to you. The article discusses the many different problems and some of the attempts made to correct them. Also discussed in detail are pulsation dampeners. (PD-1). Fluor Corporation, Ltd.

(59) Steel Mill Lubrication . . .

. . . . is the title of a booklet dealing with centralized lubrication systems as applied to blooming mill operation. This booklet summarizes the characteristics a lubricant must possess in order to lubricate all of the blooming mill bearings. It features the operation of the blooming mill because this type of mill is typical of the requirements of the steel industry. Shell Oil Company, Inc.

(60) Multi-Breakers

The new Multi-Breaker type MO 4 is described in a bulletin that is available. The bulletin includes specification data, catalog numbers, ratings, weight, price, and illustrations showing the internal workings of the breaker. (154). Federal Electric Products Company.

(61) Dust Collectors

A technical bulletin on "Hydro-Whirl" dust collectors is available. The bulletin includes information on styles, applications, advantages, sizes and technical data. It further tells how the cyclone, cloth screen arrestor and other dry collectors have now been relegated to their limited range. (101). Peters-Dalton, Inc.

(62) Carbide Dies

A booklet is available containing numerous time and money-saving ideas for anyone connected with the deep drawing of sheet metal. An outstanding application cited describes drawing operations involving highly abrasive beryllium copper. Other jobs selected to give a good idea of the versatility of carbide dies are illustrated and described. (D-120). Carboloy Company, Inc.

(63) Bearing Selection

Two books are available to you. One describes a line of roller bearing self-aligning pillow blocks of the daapter and press-fit-on-shaft types. The second describes a line of ball bearing pillow blocks, flange units, cartridge units, hanger units, take-up units, and complete take-ups. Both books contain engineering data, capacity tables and dimensions. (2095 and 2094). Link-Belt Company.

(64) Lift-O-Krane

A bulletin is available describing a machine that combines the features of a mobile crane, a fork lift truck, and a ram truck all in one. The booklet tells how this unit speeds up loading, unloading and stacking of materials. (65). Silent Hoist and Crane Company.

(65) CO Indicator

A folder is yours for the asking describing a practical carbon dioxide indicator which makes accurate flue gas tests easy. The folder tells how the "Fyrite" indicator is a convenient aid in saving fuel, stretching steaming capacity, and reducing furnace repairs. Also described is the method of operation. Bacharach Industrial Instrument Company.

(66) Grinding Machinery

A catalog is available describing a line of grinding machinery and grinding wheels. The catalog includes information on horizontal face grinders, vertical surface grinders, knife grinders, floor stand grinders, buffing lathes, cutlery grinders, cut-off machines, special grinding machines, and grinding wheels. (146). Bridgeport Safety Emery Wheel Company, Inc.

(67) Cutting Oils

An interesting presentation of cutting oils is available in a new booklet. Included is a machining guide. The booklet tells about the substantial costs in unit production costs obtainable because of the specific properties of these cutting oils insuring better performance on certain machining jobs. Gulf Oil Corporation.

(68) Oil Dilution Calculator

A simple, new calculator called a "Dilut-O-Graph" makes it possible to compute quantities in a matter of seconds, when mixing or diluting oils. Given the recommended mixing proportions, and the capacity of the tank, this calculator shows precisely how much base oil to use. D. A. Stuart Oil Company.

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president in charge of methods and processes, succeeds Mr. Browne as technical director.

Born in Bridgetown, Barbados, British West Indies, Mr. Browne went to Nova Scotia in 1907, where he spent two years before coming to Pittsburgh.

In 1912 he was promoted to technical superintendent of the open hearth department, and was made assistant General Manager in 1914. He became general manager in 1917, and in 1923 was made assistant to the president so that he might devote his entire time to the development of stainless steel. He was appointed vice president in charge of research in 1930, and a member of the board of directors in 1936. He was named technical director in 1943.

A graduate of the University of Michigan, Mr. Lounsberry began his career in 1912 with the H. H. Franklin Manufacturing Company, Syracuse, New York. From 1913 to 1916 he was associated with the Holcomb Steel Company, Syracuse, New York, and then worked for the Atlas Steel Company, Dunkirk, New York, until 1923. That year he went to Cleveland with the Hunter Crucible Steel Company, but in 1924 returned to Atlas and remained through its merger with the Ludlum Steel Company and the Allegheny Steel Company to become the Allegheny Ludlum Steel Corporation. A vice president of Ludlum, he retained that position with the new corporation after the merger.

A. W. Duncan, electrical superintendent, Weirton Steel Company, Weirton, West Virginia, retired January 1 after 37 years of continuous service at Weirton Steel. At 17 years of age, Mr. Duncan began his career

A. W. DUNCAN

in the steel mill industry, being employed with a rigger gang at the Carnegie Steel Company, Braddock, Pennsylvania, and a year later became an electrician's helper at a plant built by the American Steel and Wire Company at Rankin, Pennsylvania. After serving for a year in the Spanish-American war, he returned to the Carnegie mill at Braddock to rejoin the rigger crew. He then worked for the Apollo Iron and Steel Company, Vandergrift, Pennsylvania, for two years. In 1900 he joined the electrical department at Pressed Steel Car Company, Pittsburgh, Pennsylvania, remaining with that firm for 10 years during which time he studied and mastered a correspondence course in electrical engineering. He advanced successively from lamp trimmer to journeyman on the wire gang to foreman and then to chief electrician. In March 1910 he joined Weirton Steel to assist in the installation of the first hand operated hot mills in the tin mill, being employed as chief electrician.

Mr. Duncan is a life member of the Association of Iron and Steel Engineers and has served as a member of the Board of Directors.

John F. Black was appointed general superintendent, Buffalo plant, Wickwire Spencer Steel division of the Colorado Fuel and Iron Corporation. Mr. Black received his elementary schooling in the Enid, Oklahoma, city schools, and attended the United States Naval Academy, class of 1926. He started in the steel business as pipefitter helper at Bethlehem Steel Company's Sparrows Point plant, progressing to steel shipper, labor foreman, gashouse foreman, general foreman of gas producers, combustion engineer, and general foreman of pipe mills. In 1941 he transferred to Atlas Steels Limited, Welland, Ontario, as fuel engineer and in 1943 was made assistant works manager. Mr. Black is serving as secretary on the 1947 board of directors of the Association of Iron and Steel Engineers.

Daniel A. Bryan was appointed assistant superintendent, yard maintenance department, Carnegie-Illinois Steel Corporation, Duquesne Works, Duquesne, Pennsylvania. Mr. Bryan went with the Irvin works in June, 1937 and transferred to the Duquesne works in February 1942.

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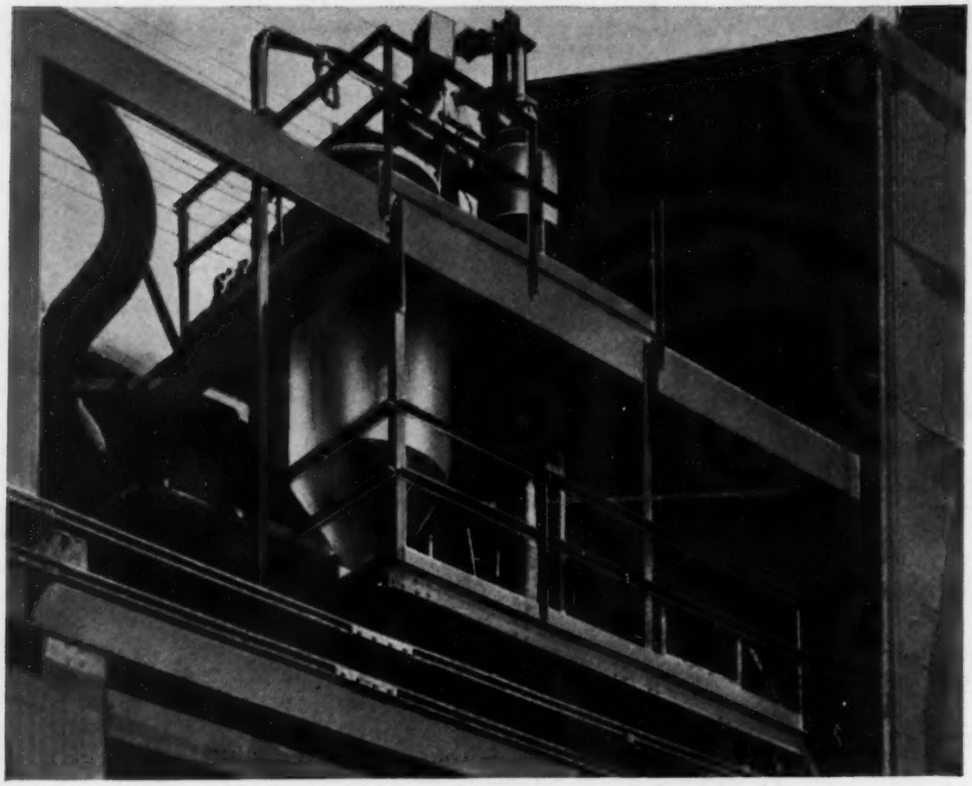

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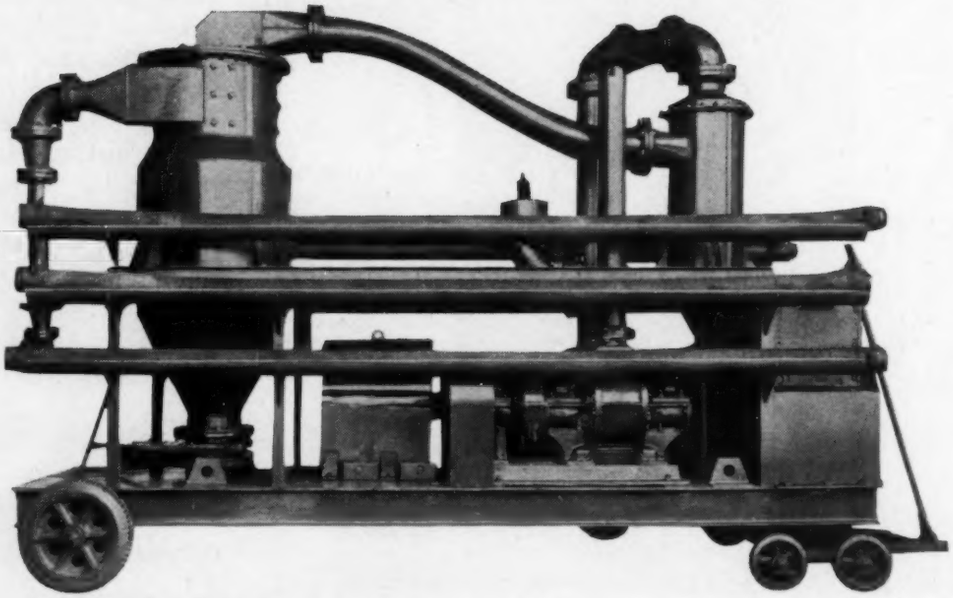

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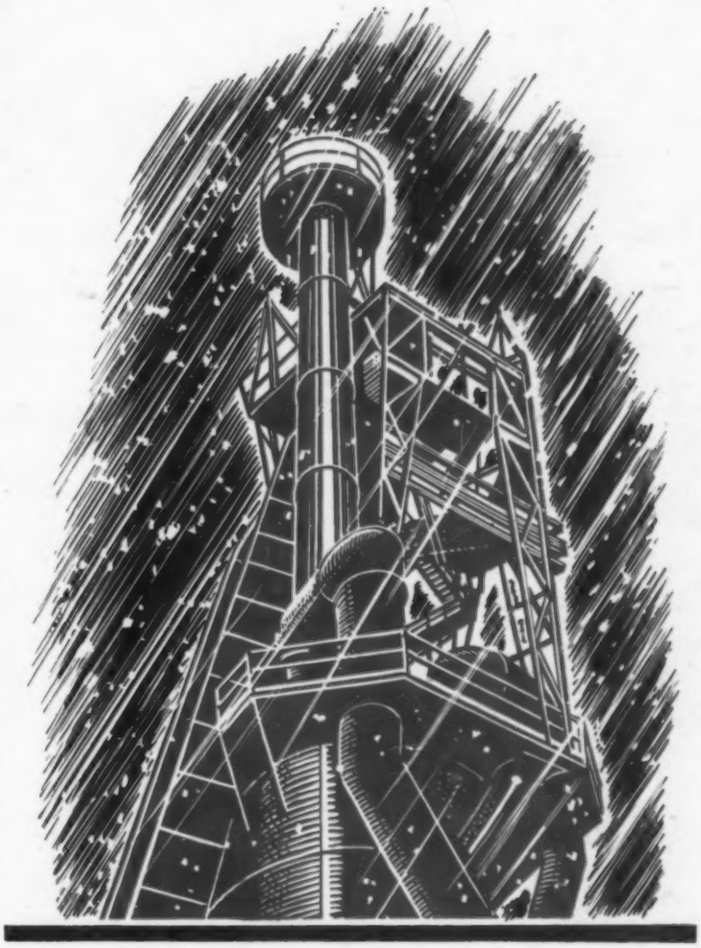
Oiling the furnace top used to take 30 minutes of three men's time. Two men made the dangerous, daily climb—one greasing the bearings, one watching for gas fumes, ready to signal for help to a third man waiting below. Climbing around on walkways and girders, 175 feet in the air, was extra hazardous in high winds or on icy winter days. No wonder that important bearings were slighted or skipped, with resultant damage to equipment and delays to production.

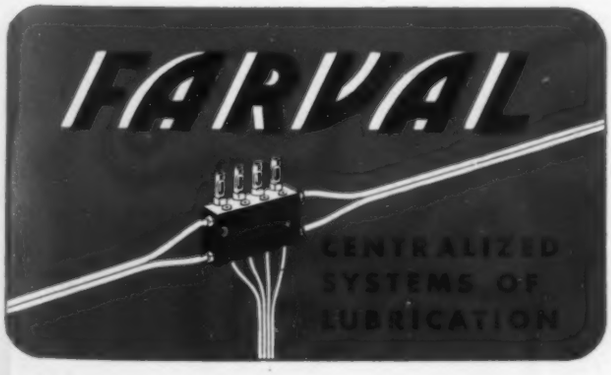
With Farval, one man quickly lubricates *all* bearings on the rotary distributor, bell beams, skip hoist, sheaves, etc., from a safe central pumping station in the Hoist House. Annual savings in oiling time and lubricants alone exceed $2500 per furnace on an installation serving 250 bearings. Even more important is the fact that regardless of the condition of the furnace or the weather, all bearings receive positive lubrication at regular intervals, and risk to human life is eliminated.

Since the first installation on a blast furnace in 1930, over fifty furnaces have been Farval equipped. Farval centralized systems also protect over a million industrial bearings—on stock bins, overhead cranes, rolling mills, presses, conveyors, in fact machines and equipment of every kind where adequate lubrication is important to efficient, economical production.

Farval is the Dualine System with the Positive Piston Displacement Valve. This valve has but two moving parts and is fully adjustable, with a Tell-tale indicator at each bearing to show the job is done. For a full description of Farval, write for Bulletin 25, The Farval Corporation, 3278 East 80th Street, Cleveland 4, Ohio.



Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited.



FARVAL—*Studies in Centralized Lubrication*
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Selection of factory-assembled Limitamp control for this plant made it possible to install a single compact group, instead of a number of separate devices, in a small amount of floor space.

Here's FAST, "PACKAGED" Short-circuit Protection for Your High-voltage Motors . . . Limitamp Control

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OPERATES WITHIN A SPLIT CYCLE

● You can give your motors sure short-circuit protection by specifying G-E Limitamp control. Faster than any breaker, this "all-in-one-unit" control, with its EJ-2 fuses, clears fault currents in a half cycle.

When a short occurs, the fuses cut off the rise in current in less than a quarter cycle. And the short is cleared long before the current has time to harm the contactors or motor.

GIVE YOUR STEEL PLANT THESE IMPORTANT ADVANTAGES

Completely co-ordinated control—Limitamp is "packaged" in a single unit which is easy to install and attractive in appearance.

Full protection—If voltage is low or power fails, the motor is taken off the line. And it will not restart on return of power. Accurately calibrated overload relays protect your motors from overheating due to sustained overloads or single-phasing.

Years of service—Air-break contactors, good for millions of operations, meet the most severe requirements of high-voltage motor-control service. Contact-tip life is many times that of comparable oil-immersed tips.

Safety for operators—And because it is totally enclosed in an all-metal case, Limitamp control provides protection for all operating personnel.

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